FLIGHT
and
AIRCRAFT ENGINEER

Editorial Director G. GEOFFREY SMITH, M.B.E.
Editor - - C. M. POULSEN
Assistant Editor - MAURICE A. SMITH, D.F.C. (WING CDR., R.A.F.V.R.)
Art Editor - - JOHN YOXALL

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The Outlook

Civil Aviation

LAST week's House of Commons debates on the Address, and the debate in the House of Lords on nationalized industries, afforded an opportunity for arguments about the operation of the nationalized industry of which most experience is available, that of civil aviation.

It cannot fairly be said that these debates produced anything very constructive, nor that they revealed anything new. That the Corporations are "in the red" was already well known. That steps are being taken to attempt to reduce losses was also known. The Minister of Civil Aviation did give a "target figure," to use the expression which has become such a favourite with our planners. "We are," he said, "absolutely determined that by the beginning of the financial year 1949-50 all possible weaknesses shall have been eliminated from the Corporations."

But even if that should come to pass, there might well be a prolonged period during which the Corporations will continue to make financial losses. It is to be hoped, of course, that they will be on a reduced scale, but there cannot be any guarantee that they will disappear, much less that they will be turned into profits. Even when Lord Pakenham's "potentially first-class athletes —a few pounds overweight—take the field trained to a hair as never before, and fit to fight for their lives," circumstances may be such as to preclude any possibility of making profits.

Civil aviation cannot, unfortunately, be entirely divorced from the wider national and international questions of politics and strategy. Apart from these, there is another angle, that of service to the public. Certain routes will obviously have to be operated even if they are unremunerative. That has often been stressed, although examples are not unknown of routes being closed-down. There was one quite recently, the Edinburgh-London, which Mr. Lindgren was questioned about last week. Air traffic is apt to be seasonal, even on routes which are extremely busy for a certain part of the year, and not all can be treated as was the Edinburgh-London.

It would, therefore, be over-optimistic to expect that our nationalized Corporations will necessarily be paying their way as soon as they are "fit to fight for their lives." Even in the United States, where geographical conditions are in many ways more favourable, where the organization of civil aviation is on a very different footing, and where, according to many, they have the world's finest airliners, most of the operating companies have been making losses. Thus we have some way to go before the taxpayer is relieved of the burden, and it would be well not to confuse the expected date of attaining Corporation efficiency with that on which air transport can be expected to "fly by itself." It may be recalled that Mr. Masefield, Director-General of Long-Term Planning in the Ministry of Civil Aviation, recently estimated ten or twelve years as the interval before air transport can be expected to do without subsidies. There are many goals to be attained, apart from making the Corporation efficient.

Remembrance

THOUGHTS of those, Servicemen and civilians, who gave their lives in the two World Wars are with us all at home and overseas this week, and last Sunday's Remembrance Ceremonies here and in the British Commonwealth once again afforded the opportunity to honour their memory in the traditional way. The Royal Air Force has its own very special day set aside for those who saved the country in 1940, the heroes of the Battle of Britain, but it, like the other Services, honoured its dead from both wars on November 7th, when wreaths were laid by His Majesty The King

and by representatives of the Services at the Cenotaph in Whitehall.

There are others who have given their lives, not necessarily in battle, and they, too, were not forgotten on Sunday, when wreaths were laid for the Merchant Navy, the Fishing Fleet and the Civil Defence Services. *Flight* desires on this historic date, November 11th, to pay a special tribute to the memory of the test pilots who have laid down their lives in the course of testing new aircraft types that the Royal Air Force, the Royal Navy and British Air Transport may have the very best equipment which our designers can provide. To these men British aviation owes a great deal.

An Anniversary

NOVEMBER 11th has another claim on our recollections than that of Armistice Day, 1918. On that day, in 1940, twenty-one Swordfish aircraft took off from the carrier *Illustrious* and flew 170 miles across the Ionian Sea to attack ships of the Italian Navy anchored in Taranto Harbour.

It was not known to the general public at the time, but actually the Italian Navy then was more powerful than the British naval forces in the Mediterranean, a fact which was disclosed after the event by Mr. Churchill. The Taranto operation changed the picture, and in commenting upon the event we said: "If Fighter Command gained the first decisive victory in this war by beating back the German attempt to prepare the way for the invasion, it may well prove that the Fleet Air Arm has won the second . . . as a result, Britain now rules the *Mare Nostrum* waves as undisputed as on the morrow of Nelson's victory of the Nile."

We may have been slightly optimistic in taking that view, but the fact remains that the Taranto operation was the first occasion on which carrier-borne aircraft proved their worth in the Royal Navy. It is not too much to say that the action had a very great effect upon naval thought, both here and in the United States of America. The aircraft carrier had been vindicated, and it may well be that it is from November 11th, 1940, that we must date the first dawning on the minds of Their Lordships at the Admiralty of the fact that carriers and their aircraft were ushering in a new era. There were individual naval officers who fully realized the vast potentialities of carrier-borne aircraft, but there were also diehards who needed Taranto to convince them.

Among the 21 Swordfish crews that took part in the operation were a few experienced night-strike aircrew from *H.M.S. Eagle*; they had embarked in the *Illustrious* before she sailed from Alexandria. The "Stringbags" took off in two waves, one of 12 and one of 9 aircraft. Thick cloud was encountered after take-off but the first aircraft dropped flares, and 450-lb armour-piercing bombs were dropped on cruisers lying side by side. Eleven torpedoes were dropped and three battleships were hit, one of which was beached and later abandoned, while the others were out of action for at least eight months. The torpedo-dropping Swordfish came in low, and took advantage of the fact that the Italian guns were trained at the bombing aircraft above. When they did get trained on the low-flying, weaving Swordfish, they shot wildly and, it is alleged, sank four of their own merchant ships.

And the price paid for the crippling of the Italian Fleet? Two Swordfish failed to return to the *Illustrious*.

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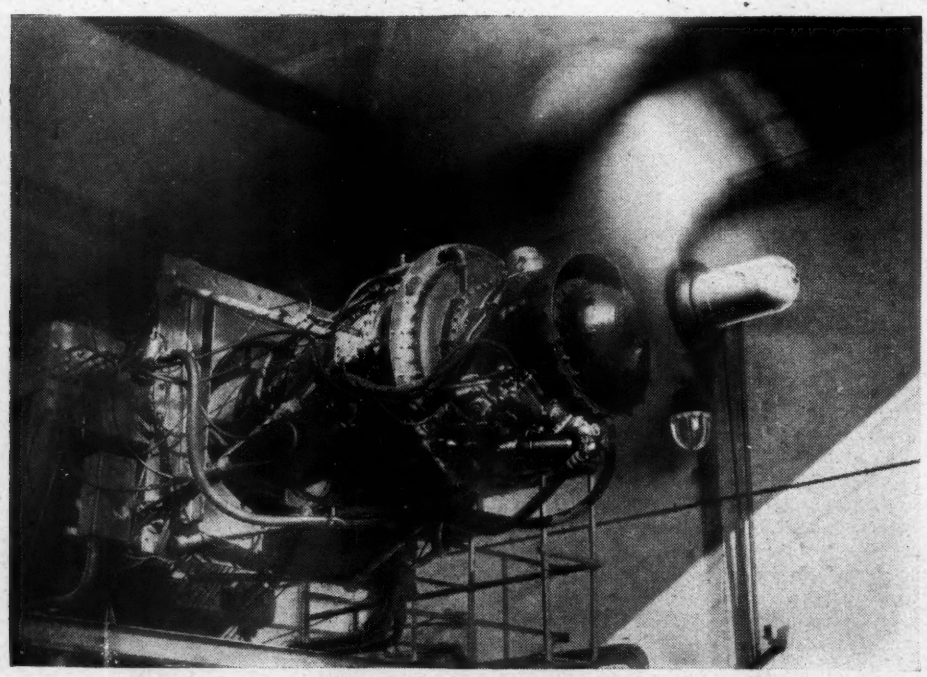
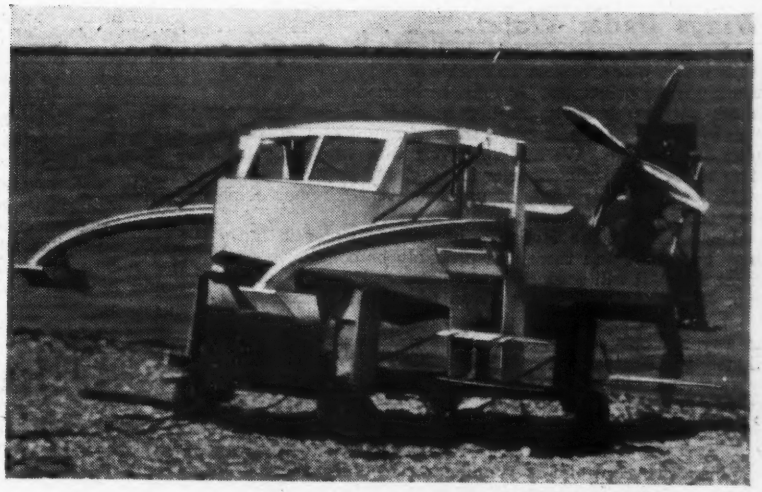


Stream of Power

THE deepest rivers flow with the least noise and the Vickers Viscount, powered with four Dart turboprop units—latest of the Rolls-Royce "River" Class—is unquestionably the quietest transport aircraft now flying. Reference to a visit by the Viscount to the Rolls-Royce Establishment at Hucknall is made on page 578. The Dart seen here on test is one of a set of four for the Viscount. In addition to 1,000 shaft horse power, this amazingly compact unit delivers 325 lb of residual thrust.

WINGS UNDER WATER

The Hook Hydrofin, a Marine Craft Which Needs the Understanding of Aircraft Technicians



A full-size Hydrofin, the HN-4, is driven by a Pobjoy aircraft engine and airscrew. The upper (auxiliary) hydrofoils are clear of the water when the craft is running.

HYDROFOIL boats, that is to say, boats supported at speed by underwater surfaces of aerofoil shape, are no new thing. Names that have become familiar in this particular field of experiment and research are numerous, and it will suffice to mention a few, such as Graham Bell, Forlanini, Crocco, and Tietjens. They all realized that, theoretically, it should be possible to raise a boat hull above the water on hydrofoils, and that for a given power far greater speeds should be attainable than were possible with displacement hulls.

Considerable success attained the efforts of these pioneers. For example, as long ago as 1919, Alexander Graham Bell, of telephone and early aircraft fame, sponsored the building of a hydrofoil boat which, at a gross weight of 11,000 lb, and airscrew-driven by two Liberty aircraft engines of 350 h.p. each, attained a speed of 71 m.p.h.

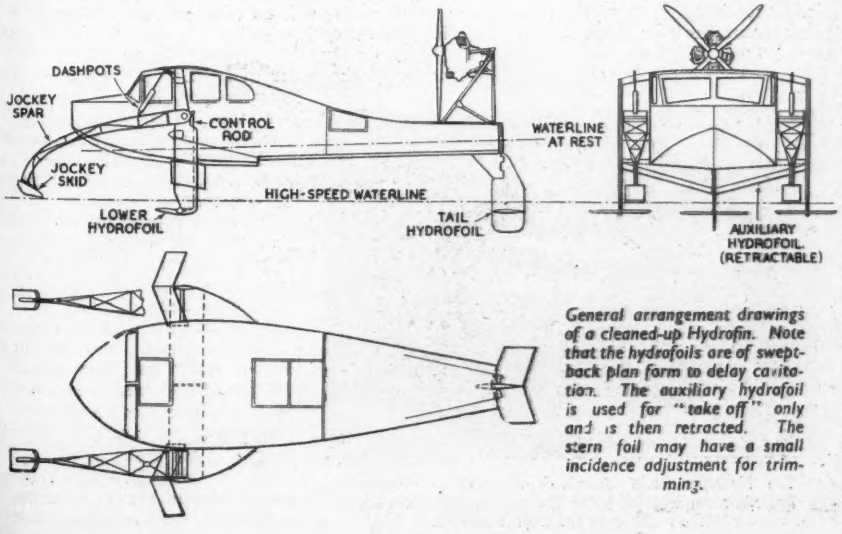
Even in times as recent as the Second World War, the Germans produced hydrofoil boats with speeds so high, in smooth water, that our displacement craft could not catch them. Why, then, it may be asked, has the hydrofoil boat not come into more general use? The answer, in the main, is that the boats produced have been capable of operating in smooth water only. In anything of a sea, the hydrofoils have broken surface and, when sinking again, have dragged down with them bubbles of air adhering to the top surface of the foils, thus reducing their lift.

Many different solutions have been tried. In the Graham Bell boat multiple superimposed hydrofoils were used, the idea being that as speed increased so more and more foils would come out of the water until, at top speed, only the lower were submerged. That worked fairly well in smooth water, but if anything of a sea was running, the exposed foils caught the waves and slowed down the craft.

Another approach to the problem was to set the hydrofoils at a large dihedral angle, so that, as the craft gathered speed, first the tips and then gradually more and more of the foil emerged. This gave a gradual reduction of submerged hydrofoil area, but it was found that the foils sucked air down the sloping surfaces and thus spoiled the lift.

An Automatic Constant-draught Device

What was wanted was a means of keeping the hydrofoils running at approximately constant depth below the surface, and it seems to have been left to Mr. Christopher Hook to devise such a means. His solution is to replace variable area by variable incidence. The main lifting hydrofoils of the Hydrofin (as Mr. Hook calls his craft) are hinged at approximately their centre-of-pressure line, and are geared by mechanical linkages to what he terms jockey skids located some distance ahead of the hydrofoils. These skids run along the surface of the water, and the linkage is such that if the craft tries to rise, the skids decrease the angle of incidence of the hydrofoils; if the craft tends to sink deeper, the angle is increased. In other words, the jockey skids are a constant-draught device. Provided there is enough power in the engine to drive the craft at sufficient speed, the foils will run at the predetermined distance below the surface, their angle of incidence decreasing with increasing speed.



General arrangement drawings of a cleaned-up Hydrofin. Note that the hydrofoils are of swept-back plan form to delay cavitation. The auxiliary hydrofoil is used for "take off" only and is then retracted. The stern foil may have a small incidence adjustment for trimming.

Readers might wonder what the Hydrofin has to do with flying. The answer is: very little and a great deal. Naval architects and boat designers, accustomed to displacement hulls, and even

Wings Under Water . . . . .

hulls which plane, appear incapable of fully understanding the Hydrofin principles. Aircraft technicians, on the other hand, will be on fairly familiar ground, because most of the hydrofoil problems have their almost exact counterpart in aerofoils. We are concerned with lift, drag, lift-drag ratio, foil loading, power loading, and so forth. Even stalling and similar kinds of unattractive behaviour come into the hydrofoil picture.

The action of the Hydrofin in smooth water is fairly easy to follow, and there will probably be common agreement that "it will work." But what about waves? Here, too, Mr. Hook appears to have found the answer. At least, he can see how to deal with waves, although not in any one size of Hydrofin. The craft must be proportioned to the type of wave in which it is intended to operate, as will be obvious from an examination of the problems.

Action in Waves

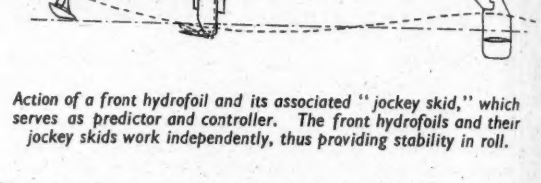
When the Hydrofin is running on its foils, there is a certain amount of clearance between the bottom of its hull and the average water level, depending on the size of the craft and the length of the struts supporting the foils. If the jockeys were entirely free to move with their supporting beams, and if the mechanism had no inertia, they would follow the surface of every little ripple (they are lightly loaded by the foils), and the whole craft would dither. The jockey beams can, however, be so controlled by springs and dampers or dashpots that the skids will skip from crest to crest on small waves, but will rise and fall with the surface of a large swell. In the former case, the craft will follow a mean curve rather than one corresponding to the water surface. In the latter, it will climb the hills and go down in the valleys. The whole thing is rather like a motor car in which the shock absorbers smooth out the smaller bumps, although the vehicle still has to follow the larger gradients.

Thus the size of wave which a Hydrofin will negotiate depends upon its length and the height of clearance between hull bottom and water surface. What constitutes a hill to be climbed by the smaller craft will be a wavelet to the large, so that the jockey skids will jump nearly from crest to crest and the craft follow a mean curve path. This skipping from crest to crest must not, of course, be overdone, or the hydrofoils might break surface. The adjustment of the damper must be such that the time lag in the dropping of the jockey skid is such that a compromise is effected between the craft following the surface of the wave in the one case and the hydrofoil breaking surface in the other.

Lest it be thought that all this is theorizing, it should be pointed out that Mr. Hook has been at work on these problems for many years; he has built many models and two full-sized craft. The first of the latter was built and tested in Africa, the second built at Cowes and tested in the Solent. The story of these efforts is one of struggle against great odds, but there is no room to tell it here, and we must confine ourselves to results.

After being rebuffed in many other quarters, Mr. Hook received his first real encouragement from the Royal Aircraft Establishment at Farnborough. Tests were made there on a 3ft model supplied by Mr. Hook. The tests were part of a general hydrofoil research programme, and were made to determine the stability of a hydrofoil system with incidence control. The model was tested in the Farnborough tank, both in calm water and in waves. One of our pictures shows the model. It will be seen that it is not very "clean" hydrodynamically, but it performed in the way Mr. Hook had predicted. That cavitation occurred in certain circumstances is scarcely to be wondered at when it is pointed out that the hydrofoils were merely flat plates with leading and trailing edges filed down thin.

Drag measurements were taken by towing the model from the nose by a length of string. As was to be expected, there was a "hump" in the drag curve in the transition region, where the lift was being transferred from the hull to the foils. By partly feathering the foils, as would be done in a full-size craft, the drag was reduced from 1.03 lb to 0.71 lb at a speed of 2.8ft/sec, and from 1.17 lb to 0.85 lb at 4.2ft/sec. After that, the craft became "foilborne," and at 6.3ft/sec the L/D ratio was 6.33, rising to 6.62 at 8.4ft/sec. After that, the drag increased approximately as V^2. The model weight to which these figure correspond was 5.45 lb.



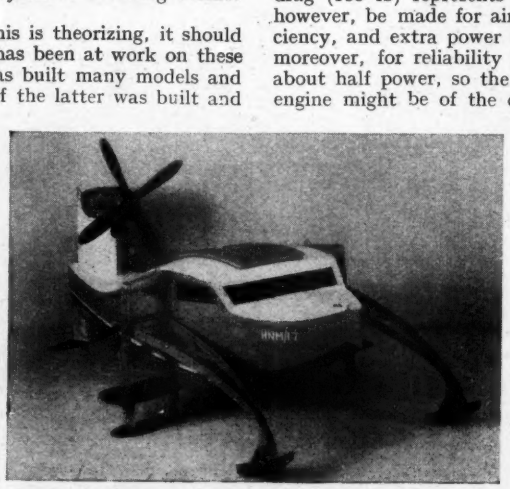
Action of a front hydrofoil and its associated "jockey skid," which serves as predictor and controller. The front hydrofoils and their jockey skids work independently, thus providing stability in roll.

In view of the relative roughness of the model (it was built to test the stability, which was proved, and not for maximum efficiency), an L/D ratio of more than 6 is not too bad. It should, however, be capable of considerable improvement, and the Farnborough report on the tests expresses the view that in full size, and with hydrofoils and their supporting struts given sections appropriate to the work, an L/D ratio of 10: 1 should be attainable at a speed of 50 knots.

Economy of Operation

Accepting for the moment an L/D of 10, and a craft so designed that it cruises at 50 knots (57.5 m.p.h.) at this L/D, it is seen that for every 1,000 lb of gross weight, the drag (100 lb) represents 15.3 h.p. An allowance must, however, be made for airscrew (or water propeller) inefficiency, and extra power will be required for "take-off"; moreover, for reliability it will be desirable to cruise on about half power, so the actual power required from the engine might be of the order of 40 h.p. per 1,000 lb of gross weight, or some 90 h.p. per ton. In terms more familiar in aviation, the power loading could certainly be as high as 25 lb/h.p. for a cruising speed of 50 knots.

It seems reasonable to suppose that the ratio of payload to gross weight would be better than is obtained in aircraft. The hydrofoils are of very small area, and even if made of solid metal they would hardly weigh as large a proportion of the structure weight as do the wings of an aircraft. The power per pound of gross weight is less than half of that used in aircraft, so engine weight should also be a smaller proportion. Fuel weight would

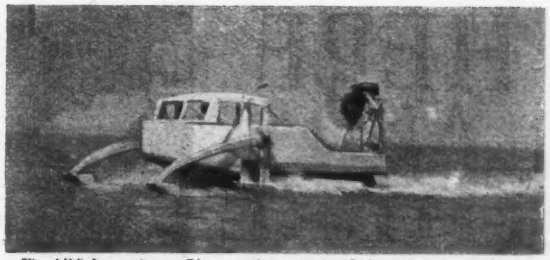


The Hydrofin model tested at Farnborough. Auxiliary hydrofoils are mounted above the main ones and rise above the water when the craft is running.

be about the same, since the lower power is offset by the lower cruising speed. It should also be possible to get more "bodies" into a given gross weight than in aircraft, so a Hydrofin would appear to promise operational economy somewhere between those of ships and aircraft.

As for comfort in such craft, small waves are "ironed-out," and in the Farnborough tests the model ran steadily with only about 2 deg. pitching. In large waves it ran smoothly over regular waves which involved up to ±0.5g. The report on the tests expresses the view that in full-size craft it should be possible to raise this to ±1g by suitable combined springing and damping of the jockey system. The report also states that stability in roll is enormously greater than that of a displacement craft, and that no difficulty should be experienced in a cross or partially cross sea, the Hydrofin rolling just sufficiently to remain perpendicular to the local water surface.

A good deal of research and experimentation will obviously be needed to bring the Hydrofin principle to full development, but its smooth and economical speed on water is so attractive as to make the effort worth while. As for aeronautical applications, something might be done with a variant in helping flying boats to unstick in a short run. The Hydrofin craft as now visualized would



The HN-4 running. The auxiliary hydro-foils are just emerging.

appear to have possibilities for Air/Sea Rescue, where the time factor is of great importance. Should it be found later, when more development work has been done, that the principle can be applied to craft of fairly large size, one can visualize (it should hardly be put stronger than that) the Hydrofin as a small aircraft carrier. Pilots would welcome the steady platform provided by its deck, and the Navy (if the Admiralty could ever conceivably be persuaded to look at a Hydrofin) would find its speed useful in getting aircraft to the scene of operations quickly.

Production for the U.S. Air Force

DETAILS of contracts awarded to manufacturers by the U.S. Air Force have recently been published in America. Defence appears to be the keynote of the present purchasing policy, the makers of the F-80, F-84 and F-86 single-jet fighters having received a large proportion of the military orders.

Boeing B-50: A total of 377 four-engined bombers in this series have been built or are now under contract to Boeing; 347 of these are sub-types B-50 A, B or D, with only minor differences, but the 30 B-50 Cs ordered are powered by the new Pratt and Whitney R.4360 "compound" engines, with General Electric variable-discharge turbines. It is reported that, due to the differences between the B-50 C and the other aircraft of the series, the former may be re-designated B-54.

Boeing C-97 A Stratofreighter: 27 of these heavy transports are on order. The wings, tail unit, undercarriage and other components of the C-97 A are interchangeable with those of the B-50.

Consolidated-Vultee B-36 A: Heavy bomber with 230-ft wing span and six 3,000 h.p. Pratt and Whitney engines in pusher installations. The Air Force contract calls for 95 of these aircraft, which may carry McDonnell XF-85 Parasite fighters.

Consolidated-Vultee L-13: Light communications and artillery observation high-wing monoplane, in a similar class to our own Auster A.2/45, powered by a 245 h.p. Franklin engine. 146 L-13s are on order.

Douglas C-24 C: An order has been placed for immediate production of 28 of these large all-purpose transports, at a cost of $95,000,000.

Fairchild C-119 B: This twin-engined cargo aircraft is an improved version of the C-82 Packet, more than 150 of which are in service with the U.S.A.F. 99 C-119 Bs have been ordered under the 1949 purchasing programme, and 37 under this year's programme.

Grumman SA-16 A Albatross: Powerful twin-engined amphibian, suitable for air-sea rescue work and also supplied to the U.S. Navy. The U.S.A.F. will receive 32 SA-16As.

Lockheed F-80 C Shooting Star: 457 F-80 Cs are to be supplied to the U.S.A.F. Over 1,000 of the earlier and less powerful F-80s have already been built. America's air reserve force, the Air National Guard, is already receiving Shooting Stars. Lockheed are also producing 128 TF-80 C two-seat trainer versions of this well-known single-jet fighter.

North American B-45: First multi-jet bomber to go into production, powered by four "paired" TG-180 axial-flow turbojets. 96 B-45 As and 94 B-45 Cs have been ordered but the differences between the two versions are not stated.

North American F-86: This latest American jet fighter to go into production recently captured the world speed record for the U.S.A.F. at 670 m.p.h. 674 F-86s will be supplied.

North American T-28: A two-seat, multi-purpose trainer, completes the trio of new North American production aircraft; a tricycle undercarriage is a novel feature. The present contract is for 268 T-28s.

Northrop B-49 and B-35: Eight TG-180 turbojets power this flying-wing bomber of 172-ft span. 32 are on order. Ten Northrop B-35s with Pratt and Whitney R-4360 compound engines are also being built.

Republic F-84 Thunderjet: The third American single-jet fighter in quantity production; 300 F-84 As have been supplied, 300 more remain to be delivered, and a new U.S.A.F. contract calls for 409 later model F-84 Cs.

Ryan L-17 B Navion: Originally a North American design, then known as the L-17A, and now taken over by Ryans, who have a contract for 158 of these four-seat personnel transports. 83 L-17As were supplied last year.

THE PLASTICS MARK

BEFORE the war, the British Plastics Federation were discussing with the British Standards Institution the necessity for evolving some official mark of quality for plastic products. Some progress was made at that time, but it is only recently that the scheme for a Certification Mark for the plastics industry had been launched.

The intention is to give purchasers an independent assurance that the marked materials and products conform to precise requirements laid down by an authority other than the producer, and the purpose is to ensure that, by the allocation and use of the Mark, materials and articles carrying the insignia are correctly manufactured according to the relevant B.S. Specification.

At present, the certification scheme is applicable only to moulding powders made from phenol-formaldehyde and urea-formaldehyde resins, and certain mouldings made therefrom. However, this is the initiation of a long-term scheme which, it is hoped, will gradually become universal.

Licences have already been issued to Bakelite, Birkbys, British Resin Products, E. K. Cole, Ferguson, Halex and I.C.I. Applications for licences applicable to products for which B.S. Specifications are available must be addressed to the British Plastics Federation or to the British Standards Institution. The factories concerned are then visited by B.S.I. inspectors to ascertain whether there are adequate testing facilities. The B.S.I. Mark sub-committee consider each application on its merits and determine, particularly from the inspectors' reports, whether the suggested testing arrangements are satisfactory or need modification.

Each applicant to whom a licence is granted will be given a code letter for use on a Certification Mark, together with a code letter and number for the particular British Standard and grade of material to which the licence refers. A licence can be endorsed for additional products.

The Certification Mark for moulding powders has been registered in Argentina, Australia, Canada, New Zealand, South Africa, Sweden and Switzerland.

A CORRECTION

LAST week, under one of the photographs taken at the R.Ae.S. Conversazione, we inadvertently married Capt. Cyril Uwin's daughter to Mr. Lawrence Wingfield. The offending inscription should have read: Mrs. Uwins, Miss Eve Uwins, Capt. Cyril Uwins and Mr. Lawrence Wingfield.

HERE AND THERE

French Nenes

SINCE the publication, in the preceding issue of *Flight*, of a photograph depicting the French NC 1071 jet trainer, it has been learned that the power units are Rolls-Royce Nenes, as built under licence by Hispano Suiza.

Pathfinder Ball

A.V-M. D. C. T. BENNETT, Patron of the Pathfinder Association, now engaged on the Berlin air lift, flew back from Berlin to attend the Pathfinder Ball, which took place at the Dorchester Hotel, Park Lane, on Saturday, November 6th.

Aviation Petroleum Conference

AN international conference to discuss the world marketing and distribution of aviation petroleum products took place at the Esso Training Centre at Elizabeth, New Jersey, during October, which was attended by representatives from marketing areas in 45 countries. The conference, sponsored by the Marketing Co-ordination Department of the Standard Oil Company (New Jersey), included technical training sessions at several American aviation plants, as well as a demonstration of a new system of aircraft refuelling for the U.S.A.F.

Pilots of Missing Aircraft Traced

AFTER two months investigation by Special Branch detectives into the disappearance last September of Beaufighter and Halifax aircraft from Britain it is understood that detailed reports have been sent to the Home Office, Ministry of Civil Aviation and the Director of Public Prosecutions. Several of the pilots believed to have flown the aircraft out of this country have been traced and have made statements to the police. There is a possibility that actions against these pilots may be brought for alleged contravention of customs and emigration regulations.

TEST PILOTS AT AVROS: Members of the Seventh Test Pilots' Course from the Empire Test Pilots' School, Farnborough, recently visited factories of A. V. Roe Ltd., at Woodford and Chadderton and also the Rolls-Royce establishment at Hucknall. Here Mr. S. D. Davies, Avro's chief designer, is explaining a metal-to-metal bonding process to S/L. R. E. Havercroft, C.F.I.

G. H. Miles Joins Airspeeds

UNTIL recently director and chief designer of Miles Aircraft, Mr. G. H. Miles has joined the staff of Airspeed, Ltd., as assistant chief designer. Besides his extensive design experience Mr. Miles has flown more than seventy types as a test pilot. He will be based at the Airspeed Christchurch factory where design, development and production work on Ambassadors is in progress. Mr. A. E. Ellison, who has been responsible from the start for the detail design of the Ambassador, has now been appointed chief development designer.

Mr. G. H. Miles.

Berlin Air Lift Cost

REPLYING to a question put by Sir Waldron Smithers in the House of Commons on November 1st, Mr. Mayhew, Under-Secretary of State for Foreign Affairs, stated that up to October 26th the extra cost to the Exchequer of the Berlin air lift was approximately £2,300,000. The actual cost per week, it was stated, varied according to the number of sorties, which depended to some extent on the weather, but the average weekly cost during October was £185,000. No information was available as to the costs shouldered by the U.S.A.

Tribute to R. Kronfeld

SINCE the accident to the General Aircraft tail-less glider in which Robert Kronfeld met his death, reported in *Flight*, February 19th, there has been a growing desire amongst those who knew him and his work to pay tribute to his memory. It has been proposed, therefore, that a fund should be created by public subscription, the main objective of which should be the encouragement of the gliding and soaring movement in which Kronfeld held a pre-eminent position. A committee has been constituted for the purpose of making this appeal and receiving subscriptions, and this committee consists of Messrs. F. F. Grocombe, B. A. G. Meads, J. Laurence Pritchard, S. Scott Hall, Lord Semphill, B. S. Shenstone, P. A. Wills and L. A. Wingfield, who is chairman. Those wishing to support this project should send subscriptions to Mr. Lawrence Wingfield, c/o the Royal Aeronautical Society, 4, Hamilton Place, W.1, marked "Kronfeld Memorial Fund."

TESTING RAMJETS: After a year's experimentation with ramjet power units a Lockheed F-80 Shooting Star has flown with two such propulsion units mounted on the wing tips After flying on the Allison turbojet the 20-inch diameter ramjets were ignited and the gas turbine switched off. This F-80 is said to be the first piloted aircraft to fly on ramjets alone.

Combustion Chamber Development

ARMSTRONG SIDDELEY MOTORS, Ltd., of Coventry, makers of the Python and Mamba gas turbines, have developed a new type of combustion chamber which is to be produced in America. The arrangement will result in an important addition to the country's dollar earnings. It is understood that the combustion chamber is of the vaporizing type in which the fuel-air mixture is pre-heated as it enters the combustion chamber. Such a design was

HERE AND THERE

described and illustrated together with the complete Mamba turboprop to which examples are fitted, in *Flight* dated March 18th, 1948. Particular advantages of this design are combustion stability at high altitudes, the ability to re-light under the most adverse conditions and reduction to a minimum of distortion in the chamber.

Derby Lecture

S/L. H. F. KING, M.B.E., who has been on the editorial staff of *Flight* for 17 years, delivered a lecture on "Fighter Aircraft" to the Derby branch of the Royal Aeronautical Society on November 1st. A number of his listeners, who included Rolls-Royce technicians and pilots, and totalled over 100, questioned Mr. King at the conclusion of his talk. An article based on his lecture, the first portion of which appeared in the preceding issue of *Flight*, is concluded on pages 571 to 575 of this issue.

SAAB Shows a Profit

THE Swedish aircraft company, SAAB, has published accounts for the year 1947-8, which showed a net surplus of 1,710,000 kroner after depreciation allowances for buildings, machinery and materials amounting to 1,640,000 kroner had been made; this surplus was a small increase over that of the previous year. The sum at the disposal of stockholders, including the balance carried forward, was 2,370,000 kroner. The proposed dividends of 6 per cent on the original stock and 5 per cent on preferred stock remained the same as last year.

Saunders Roe Appointment

APPOINTMENT of Mr. F. A. Kerry, B.Sc., A.F.R.Ae.S., as assistant chief designer of Saunders Roe, Ltd., has been announced by the company. Mr. Kerry joined Saunders Roe, Ltd., in 1929, working in the stress office; he was appointed chief technician in 1934. He was formerly with A. V. Roe and Co., Ltd., from 1924 to 1929, and was one of the original members of the Hampshire Flying Club.

Mr. F. A. Kerry

U.S.A.F. Constellations

AT the Lockheed factory at Burbank, California, the first test flight of the C-121 version of the Constellation has been successfully completed. This machine was the passenger type designated C-121B. One of these Constellations will be used for special missions and long distance flights by high U.S. Government officials, while the nine others ordered by the Air Force are of the cargo type known as the C-121A. These aircraft operate at the new maximum take-off weight of the Constellation which is 105,000 lb.

***TESTING CONTINUES:** The French S.E.3000 helicopter is based on the Focke-Achgelis F.A.223 and is powered by a Bramo Fafnir double-row engine which gives 1,000 h.p. for take-off. Accommodation is for crew of two and four passengers.*

News in Brief

THE first Gold Badge of the Roadfarers' Club was recently awarded by the Council to Lord Brabazon of Tara in recognition of his services to Transport and to the Club.

* * *

Under the management of Mr. H. Clements, assisted by Mr. K. Walker, the northern headquarters of Silentbloc, Ltd., and of their subsidiary the Andre Rubber Co., Ltd., have recently been opened at 11, Cloth Hall Street, Huddersfield.

* * *

A Dakota belonging to Hornton Airways recently completed 238 hours flying in 25 days between September 25th and October 19th between Hamburg and Berlin. On September 27th during a 24 hour period the highest number of hours flown, 19 hours 38 minutes, was achieved.

* * *

No fewer than 150 members of B.O.A.C. air crews have now flown more than a million miles. Out of this total 102 are aircraft captains, 42 are radio officers and 6 are engineer officers. All except about 10 pilots who now hold administrative posts in the Corporation, are still flying on B.O.A.C. services.

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Alexander Duncan, aviation division manager of R. K. Dundas, Ltd., is to be married on November 26th to Miss Anne Walker. Miss Walker, who is in the R.A.F.V.R., was a ferry pilot in the A.T.A. during the war. The reception will be held at the Aviation Centre, Londonderry House, Park Lane, W.1.

* * *

A new record for commercial flights has been claimed by Eastern Airlines for a flight from New York City to Washington in 34 minutes; this is 19 minutes 45 seconds less than the former record. On this 200 mile trip a new type Constellation averaged 370 m.p.h. and attained a top speed of 406 m.p.h. The pilot was Capt. P. S. Wooley.

* * *

To expedite the turn-around of aircraft, especially on the Berlin Air Lift, the R.A.F. have placed an initial contract for 6 "Stacatruc" fork lift trucks, 5 of which have already been flown to Berlin. It is estimated that these will cut the time needed for loading and unloading aircraft by about 50 per cent.

* * *

Former students of the Colleges of Automobile and Aeronautical Engineering, Chelsea and Wimbledon, will be holding their annual reunion dinner on Saturday, November 20th at 7 p.m. in the Albert Restaurant, 52, Victoria Street, S.W.1. Tickets, price 12s 6d, may be obtained from H. A. Craw, A.F.R.Ae.S., 30, Cranley Gardens, London, S.W.7.

* * *

For "valuable service in the air" Radio Officer J. E. Giles of B.O.A.C. has been awarded the M.B.E. The investiture was made by Viscount Alexander of Tunis, Governor-General of Canada, at Ottawa on November 4th. Mr. Giles is now Chief Radio Officer Instructor of B.O.A.C.'s North Atlantic line in Montreal and will move to the new base at Bristol later in the year.

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From Stirling, Scotland, Mr. D. MacDonald in 1947 went to Queensland, Australia to become a flying dentist. His practice now covers an area larger than his native country. Since making his headquarters at Cloncurrey in North West Queensland, last year Mr. MacDonald has travelled over 12,000 miles by air, train and road and seldom gets more than about 3 days a month at home.

* * *

Following the resignation of Mr. H. Seabrook-Smith from Westminster Airways, Ltd., the London office of this company is now in the charge of Mr. R. J. Durand who has for the past 18 months been Traffic Manager. Capt. Powell, formerly chief pilot has, by agreement with Westminster Airways, become personal pilot to Lord Beaverbrook and in his place Capt. T. St. B. Freer, D.F.C., has been appointed chief pilot of the company.

CIVIL AVIATION NEWS

Association to Assist Charter Business : Martin 2-0-2 Considered Safe : American Airports on a Profit-making Basis

UNOBSTRUCTED VIEW : Taxying past the Le Bourget hangar at Schiphol in a Fokker Promoter. The forward view from the cabin is excellent. Each hangar at Amsterdam is named after another international airport. *"Flight" photograph.*

B.O.A.C. STAFF CUTS

REORGANIZATION in B.O.A.C., entailing the pruning of staff establishments at home and overseas is in the early stages. Part-time Directors Lord Burghley, Major R. H. Thornton, Sir Clement Jones and Lord Douglas have volunteered to serve at fees reduced from £1,000 to £500 a year. Several high executive posts have been abolished including those of Public Relations Director and Administrative Director, from which G/C. F. W. Winterbotham and Mr. G. T. Meller respectively have resigned. The posts of Secretary and Solicitor have been telescoped and Mr. K. H. Staple has become both Secretary and Legal Adviser, while Mr. D. S. S. MacDowall has resigned. Major J. R. McCrindle, previously Managing Director of External Affairs has now been appointed Adviser on International Affairs to all three British Airways Corporations but at the same time remains a member of the B.O.A.C. Board. It is understood from Sir Miles Thomas, Deputy Chairman of the Corporation, who is in charge of the reorganization, that a mission to the Middle East has recently returned and arrangements are in hand for a reduction in B.O.A.C. staffs amounting to some 450-500 in that area. Other economies in overseas station costs are to be expected.

AIR BROKERS' ASSOCIATION

ON Wednesday, November 3rd, air brokers met at the Baltic Exchange and unanimously resolved to form an Air Brokers' Association. The Air Freight Advisory Committee was authorized to investigate its financial requirements and submit detailed proposals. It is understood that the Air Freight Advisory Committee is already too fully occupied to give that information on activities all over the world that is necessary for the growing air charter business, and brokers believe that full-time attention should be paid to publicizing the activities of the Exchange, investigating potential markets, and passing such information to the brokers. The result, it is understood, would be beneficial not only to the brokers but indirectly to the air charter companies who feel that considerable business is being lost through lack of such information, and publicity overseas. The Association would be maintained by the subscriptions from member brokers. It is rather interesting that of some 70 members of the Baltic who have indicated their interest in air matters there are barely one-third who are actually active in the air market. Many of the others have been watching the trend of the market and it is believed that with an efficient Air Brokers' Association there would be a noticeable increase in business.

I.C.A.O. VICE-PRESIDENTS

THREE Vice-Presidents have been elected by the Council of the International Civil Aviation Organization; First Vice-President, Mr. Henri Bouche (France); Second Vice-President, Mr. D. Chakraverti (India); and Third Vice-President, Dr. E. M. Loaeza (Mexico). In addition the Council has elected Mr. Stuart Graham (Canada) as Chairman of the Air Navigation Committee; Sir Frederick Tymms (United Kingdom) Chairman of the Committee on Joint Support of Air Navigation Facilities; and Dr. Paul T. David (United States) as Chairman of the Air Transport Committee. Members of the Air Transport Committee are: Captain A. A. Irungaray (Argentina), Dr. K. N. E. Bradfield (Australia), Lt. Col. Jean Verhaegen (Belgium), Brigadier C. S. Booth (Canada), Mr. Y. C. Wu (China), Mr. Henri Bouche (France), Ali Fuad Bey (Iraq), Dr. E. M. Loaeza (Mexico), Dr. F. H. Copes Van Hasselt (Netherlands), Mr. G. Hulstrom (Sweden), Sir Frederick Tymms (United Kingdom), Dr. Paul T. David (United States).

SABENA PROFIT

FROM the balance sheet recently published by Sabena the Belgian Airline, profits are announced amounting to 1,020,200 Belgian francs in 1947. During the year more than 20,000 passengers were flown on the Brussels-Leopoldville route alone and 13 per cent of the total mileage flown was in the carriage of freight compared with 5.9 per cent the previous year. In the Belgian Congo the air network extends over about 7,500 miles, through 20 centres of population. The company employs 2,946 of which 228 are air crew and 655 natives. The airline has six Convair 240 aircraft on order for replacing the DC-3s on European routes. Early delivery is hoped for and they are expected to start operations during the first half of next year.

MARTIN 2-0-2 IN SERVICE AGAIN

NORTHWEST AIRLINES, the American domestic operating company, has restored its fleet of Martin 2-0-2 aircraft into full service. Subsequent to a fatal crash of one of these aircraft on August 29th, a microscopic crack was found in the wing structure of another Martin 2-0-2 which had flown through a storm and it was thought that a possible weakness in the wing structure existed. The airline then voluntarily grounded the entire fleet and together with the manufacturers and the Civil Aeronautics Administration a series of rigorous tests were carried out. It is understood that although no structural weakness was in fact found some wing strengthening has been insisted upon by the C.A.A. in view of the possibility of metal fatigue after prolonged service, or under extreme stresses in violent weather conditions. Since these precautionary measures have been taken Martin 2-0-2 wings have been tested thoroughly and the C.A.A. are satisfied.

A.O.A. ANTICIPATES CARGO INCREASES

OFFICIALS from American Overseas Airlines met in London on October 23rd to discuss ways and means of assisting the delivery to Europe of goods under Marshall Aid. Since there has already been an increase in the amount of air cargo carried since Marshall Aid was introduced, the meeting considered there would be progressively more as the European recovery programme developed and as European countries were able to export more. One way of hastening delivery was the simplification of manifests and all procedures, and A.O.A. are

suggesting steps which could be taken to eliminate duplication where shipments are handled by more than one carrier. It was pointed out at the meeting that the smaller but more frequent air cargoes out of Europe assisted the manufacturers since money that would normally be tied up in large stocks would be released for other purposes. The Airlines' participation in the Berlin air lift was also discussed, particularly with regard to the possible use of more simple shipping documents for carriage within Germany. It was revealed that A.O.A. ground crews in Germany were able to turn-round in 1½ hours a DC-4 carring 17,000 lb load.

AIR CHARTER MARKET

THE Berlin air lift continues to account for the scarcity of charter aircraft for other purposes, but the position has eased a little and a few Dakotas, Halifaxes and Liberators have recently become available. Interesting charter enquiries included one for flying two buses, one from Stockholm to Bucharest and one from Stockholm to Sofia. The largest weighed over 4 tons, was 6½ metres long and slightly over 2 metres high and wide. It appeared probable that the most suitable aircraft was the Bristol Freighter into which the buses could be easily driven. Fruit is being carried from Valencia at £75 a ton, and Liberators carrying 6½ tons and Halifaxes carrying 6½ tons have been offered at rates between £75 and £80 per ton. The Paris Air Freight Exchange has now started but at the present time it is open only on three days a week. Fruit from Valencia for the London market is also being worked on the Paris Exchange where Halifax aircraft are available, but it is understood they are more expensive.

AIRFIELDS ARE ASSETS IN AMERICA

MUNICIPAL airports in the United States earned more last year than ever before and for the first time many finished the year showing an operating profit. Enterprises not directly connected with aviation have accounted for more than two-thirds of the income, and among the profit-making ground facilities provided at the airports were clothing stores, chemists, photographers, barbers' shops, post offices, banks, taxi and bus services and, of course, the usual promenade deck for visitors. Receipts at La Guardia Airfield, New York, were the largest, but owing to expansion costs that airport operated at a loss; the income for the first six months of 1947 was £159,000, but expenditure exceeded £200,000. Miami International Airport made a profit of £95,000, and other airfields including those at Dallas and St. Louis reported incomes which were more than double the total expenses.

NORWEGIAN LIGHTWEIGHT FLOATS

NORSK FLYINDUSTRI A/S, a Norwegian firm operating from Fornebu airfield, near Oslo, has developed a new type of float suitable for small aircraft. They are of sturdy construction and are designed to permit installation on all normal types of light aircraft up to a maximum gross weight of 3,080 lb. A Fairchild UC-61-A has been so fitted, and certified as fulfilling the requirements of the United States C.A.R. Part O4, and the Norwegian Ministry of Transport and Communications, Civil Aviation Department, has also approved them as independent equipment for aircraft up to that weight. The length is 19 feet, height 26 inches, width 28½ inches, and the draught with a fully laden aircraft is 17¾ inches. Displacement is 2,920 lb, block coefficient 0.485 and thread of the floats 93 inches. Designed with six watertight compartments each having a hand-hole for inspection, bilging and minor repairs, the decks can be completely removed. Each float is protected by a bumper in the bow, mooring bollards fore and aft, and a retractable water-rudder. The floats are connected to the spreader bar tubes by four vertical bolts outside the floats, thus ensuring water-tightness. All the struts are constructed of cold-drawn streamline tubes and all steel parts are cadmium plated and sprayed with aluminium lacquer.

The struts are internally protected with linseed and all control cables to the water-rudders are of stainless steel. Easy manœuvring on the water is claimed and with a full load in calm water the Fairchild, equipped with a 200 h.p. Ranger engine, is stated to have taken off in 25-30 seconds.

DIVERSION AIRFIELD—TURNHOUSE

THE day after Turnhouse airport was closed to scheduled traffic for the winter, Renfrew was fog-bound and unable to accept any traffic. Aer Lingus Dakotas were diverted to Turnhouse and passengers booked to fly from Scotland to Ireland were taken by road from Glasgow to Edinburgh. To handle the unexpected traffic, Customs officers were rushed to Turnhouse from Leith Docks, and other airport personnel, made redundant the day before, were recalled for temporary duty. Meanwhile, passengers for Edinburgh who would have landed at Turnhouse at 1100 hours on summer schedules actually arrived at Princes Street, Edinburgh at 1530 hours having travelled by coach from Prestwick.

FINNISH AIRLINE ANNIVERSARY

THE Finnish airline Aero O/Y celebrated its 25th anniversary on November 1st. The first route was opened in 1923 between Helsingfors and Tallinn with a Junkers F-13 carrying four passengers. The following year in co-operation with A.B.A. a new service was started from Helsingfors to Stockholm. The number of passengers carried in 1924 was 269, and in the first half of 1948 was 30,192. The company now has about 415 employees, of whom 12 are pilots and 33 are other aircrew. The fleet consists of two JU-52s, two Douglas DC-2s and eight Douglas DC-3s, one of which is a freighter.

U.S. AIRLINES MOBILIZATION PLAN

PLANS are being made to give the United States Air Force almost complete control of the civil airline fleets in the event of an emergency. The Military Air Transport Service which is responsible for both the Air Force and Navy transport aircraft are submitting a plan to the Joint Chiefs of Staff for approval. Both scheduled airlines and charter operators would be required to co-operate with M.A.T.S. to perform any service that might be requested.

The Air Transport Association has estimated that members could make available more than ten times as much air transport as was available when the last war started, since scheduled airlines now fly 1,054 aircraft and the charter companies about 150. The M.A.T.S. operates about 540 transports. By increasing the daily use of aircraft by about 50 per cent and paying less attention to the convenience of passengers when arranging schedules it has also been estimated that one-third of the airlines' fleet could be turned over to the Air Force in wartime without reducing the frequency of civilian services. Whereas the civilian fleet in 1941 was made up mostly of twin-engine aircraft, there are now 103 DC-6s, 264 Skymasters, 72

AIRPORT TRAFFIC IN SEPTEMBER

FIGURES issued by the Ministry of Civil Aviation for the month of September show that more air freight and air mail passed through London Airport than any other M.C.A. or licensed airport in the U.K. The figures for September, 1947, were 731,476 lb of freight and 488,198 lb of mail. Of the 38,402 passengers on scheduled services who passed through the airport, there were 77,381 arrivals and 21,021 departures involving 1,058 aircraft arrivals and 1,069 departures. The total aircraft movements include, in addition to airline schedules, charter, military, private, test, instructional, official and joy flights. Transit passengers are not included in the figures for passenger traffic.

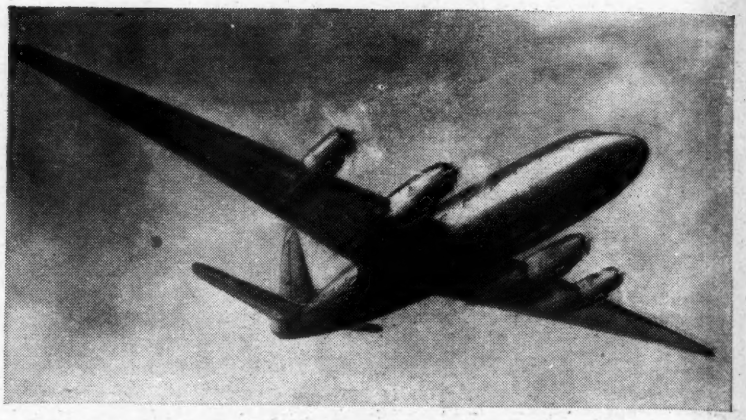
	All aircraft Movements		Scheduled Movements		Scheduled Passengers	Mail	Freight
	Arr.	Dep.	Arr.	Dep.		lb.	lb.
Aldermaston	779	791	—	—	—	—	—
Belfast (Nutts Corner) ...	1,500	1,495	339	339	9,349	50,320	64,777
Birmingham (Elmdon) ...	923	923	—	—	—	—	—
Blackpool (Squires Gate)	2,671	2,671	—	—	—	—	—
Cardiff (Pengam Moors)...	—	—	186	185	1,515	—	—
Croydon	1,279	1,277	84	84	571	—	—
Edinburgh (Turnhouse)...	—	—	98	97	2,384	—	5,281
Hurn	715	715	25	25	114	—	—
Isle of Man (Ronaldsway)	874	874	437	437	10,190	52,064	284,377
Liverpool (Speke) ...	1,373	1,355	333	333	9,614	88,871	64,920
London Airport	1,588	1,588	1,058	1,069	38,402	534,302	1,265,030
Manchester (Ringway) ...	1,079	1,070	285	287	7,634	357	73,960
Northolt	2,352	2,356	1,793	1,797	61,921	365,439	772,543
Prestwick	743	743	349	345	4,847	7,936	69,789
Renfrew	668	668	539	540	13,464	42,633	61,712
Southampton (Eastleigh)	1,199	1,211	220	220	5,103	—	11,502
Southampton Water ...	—	—	31	32	1,185	18,770	52,727
Weston-super-Mare ...	903	908	—	—	—	—	—

Civil Aviation News . . .

Constellations, in addition to 505 Dakotas. The remaining 110 include new Martin 202s and Convair 240 aircraft, which are steadily replacing older types on the air routes. The Military Air Transport Service has 9 Globemasters, and the rest of the fleet is made up of Skymasters and Dakotas. The M.A.T.S. expect, however, to receive 10 Constellations for trans-Atlantic service before March next year.

AMERICANIZING ICAO

A. CDRE. HARVEY asked the Parliamentary Secretary to the Ministry of Civil Aviation in the House of Commons on November 3rd on what dates advertisements for important posts in the International Civil Aviation Organization were published in the British Press. Mr. Lindgren replied that the vacancies had not been advertised in the British Press but the M.C.A. had circulated, towards the end of July, a memorandum giving particulars of those posts to such civil aviation organizations and Government departments in this country as might be interested. A. Cdre. Harvey then pointed out that some 50 posts carrying salaries from £750 to £2,750 a year were advertised in American newspapers at the beginning of July and he asked why American citizens should have an unfair advantage over British citizens in applying for those posts in an international organization. Mr. Lindgren then made the rather irrelevant statement that American citizens would only have had an advantage if British applications could not get in in time, but as the closing date was September 1st applications from Britain were in time. No explanation was given as to why publicity of the vacancies was restricted to the limited circulation of a Ministerial memorandum.



FRENCH LONG-RANGE TRANSPORT: The SE 2010 will fly over long-haul routes including the North Atlantic with Air France. The estimated cruising speed is 272 m.p.h. at nearly 20,000 feet. Powered by four 3,500 h.p. Pratt & Whitney Wasp-Major R-4360 engines, it will provide accommodation in a pressurized cabin for 60 to 160 passengers, depending of course upon the range. Wing span is 160 feet 7 inches, length 129 feet 10¾ inches

BREVITIES

THE Danish Ministry of Communications has allocated 45,000 kroner towards the installation of additional radio beacons at Kastrup, Copenhagen.

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On October 23rd a Lockheed Electra, of New Zealand National Airways Corporation, with 11 passengers and a crew of two disappeared over the centre of North Island, New Zealand. After the Captain had reported that he was flying in 10/10ths cloud nothing more was heard of the aircraft.

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Capital Airlines, the U.S. domestic airline company, has reported an operating profit of £21,363 for the month of September this year, the fifth consecutive month that a profit has been shown. Net profit for the month was £13,667 on a total revenue of £500,185. Working expenses were £478,822.

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Mr. G. S. Lindgren, Parliamentary Secretary to the Ministry of Civil Aviation, stated in the House of Commons last week that the Government had approved B.E.A.'s decision to suspend the Edinburgh-London service. Suspension had been made necessary, he said, by the small demand for the service last winter, and the fact that Turnhouse airfield required further navigational aids.

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A.B.A. has sold four of the Douglas DC-6s which were ordered but have never actually been delivered. Trans-Australia Airlines have bought them for £803,970. The original order was for ten of this type for A.B.A. and seven for D.D.L., D.N.L. and S.I.L.A. When the S.A.S. programme for 1948 was prepared it was decided that four of the 17 would not be required.

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In the five tourist months, May to September, 28,098 passengers flew from the United States and Canada to Britain compared with 25,297 for the corresponding period last year. This does not include passengers who flew to the Continent from Britain or travelled direct to Scandinavia. 6,910 passengers were flown to Britain from the U.S. and Canada in June, 6,737 in July, 4,305 in August and 3,519 in September. A.O.A. flew 11,043 passengers of this total during the five months.

The second of a series of ICAO training programmes will begin at ICAO headquarters in Montreal on January 17th. The prime purpose of the course is to acquaint trainees nominated by member States with ICAO and its operations.

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Commander V. Wolfson, O.B.E., V.R.D., Manager of External Affairs I in B.E.A., has been appointed Deputy Chairman of International Aeradio, Ltd. He will continue to act as M.E.A. I for B.E.A., an appointment which is mainly concerned with the formation and development of the Associate companies set up in Europe by British European Airways. Sir Victor Tait is chairman of International Aeradio, Ltd.

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Five members of the Isle of Man Airport Board recently visited Schiphol, Amsterdam. They are making a study of certain international airports for guidance in the expansion of Ronaldsway. Air traffic into the Island had increased by 50 per cent this year and the Committee has planned to make the Airport thoroughly up to date and efficient as part of a programme to encourage visitors by air.

* * *

The Financial Secretary to the Treasury revealed in the House that the industrial staff of the Ministry of Civil Aviation increased by 71 from 2,066 on April 1st, 1948, to 2,137 on July 1st, 1948. The staff of the Ministry of Supply increased by 741 from 61,827 to 62,568 over the same period. In a table of subsidies granted to industry it was shown that Civil Aviation received £10,556,033 for the year 1946-47, £9,960,000 for the year 1947-48, and £7,500,000 had been voted for the year 1948-49.

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To encourage traffic from London to Australia and New Zealand travelling east to west, across N. America, Pan American Airways have reduced fares by more than £20 to £260 single and by more than £40 to £468 return on the London-Sydney route. On all P.A.W.A. special Commonwealth services fares now include transfer charges, meals and accommodation expenses up to £2 10s a day in New York and £3 10s a day at San Francisco. In addition to a free baggage allowance of 66 lb the Company also arranges rapid surface

shipment of extra baggage from the U.K. to Australia and New Zealand. On the stage from San Francisco to Sydney and Auckland, Constellation accommodation includes the P.A.W.A. "Sleeperette" service which incorporates fully reclining seats curtained off to achieve individual privacy.

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The Fuad El Awal International Land and Marine Airport on Lake Mariut outside Alexandria consists of an artificial basin 3,000 yards long and 2,500 yards wide. The depth of water in the centre is about 11 feet. There is a slipway for servicing flying boats and a floating dock will shortly be put into use to enable embarkation without the use of a motor launch. This alighting area has taken the place of the Nile at Cairo on the B.O.A.C. flying boat route.

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Aer Lingus winter schedules which came into operation on October 31st, as mentioned briefly in *Flight*, October 14th, comprise five flights each way daily between Dublin and London, except on Sundays when services are reduced to three. The Dublin-Shannon-London service will operate on Wednesdays and Saturdays only; Dublin-Liverpool twice daily with no Sunday service; Dublin-Glasgow one flight each week-day, but two on Mondays and Fridays; Dublin-Manchester twice each week-day but one flight on Wednesday; Dublin-Manchester-Amsterdam (with K.L.M.) four times a week; and Dublin-Paris twice weekly, on Mondays and Fridays. The Dublin-Isle of Man holiday service has been suspended.

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During the coming winter season 48 weekly flights will be operated between Switzerland and England compared with 19 weekly flights during the winter season 1947. Commencing December 17th B.E.A. will operate 14 flights a week between Zurich and London and from December 11th Swissair will open a twice-weekly service between Zurich and Manchester. The Basle-London, Geneva-London and Zurich-London services have all been increased.

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In answer to a question in the House of Commons, Mr. G. R. Strauss, Minister of Supply, said of the Brabazon project that the increase in cost (£520,000) on the figure mentioned in the report from the Select Committee on Estimates, was due mainly to the increased cost of labour and materials on the works services at Filton. Those services accounted for £5,630,000 of the total £11,580,000, and the balance of £5,950,000 was the estimated cost of the two prototypes including engines, development, and manufacture of special equipment. Whereas the contract for the works services were put out to open tender the contract for the prototypes had not been.

FROM THE CLUBS

A SHARP increase in flying hours took place during October at the West London Aero Club at White Waltham keeping the three permanent instructors very busy. Since the opening of the new club lounge on September 25th membership has increased satisfactorily and the Club is now comfortably settled in its new quarters. The programme of winter attractions will begin with a dance on Saturday, November 27th.

* * *

THE British Gliding Association announce that there is to be a show by Mrs. Ann Douglas of photographic slides taken during the International Gliding Competitions in Switzerland last July. The date is Friday, November 12th, at 6.45 p.m., and the show will be held in the Library at Londonderry House, Park Lane. It will be followed by a talk by Mr. P. A. Wills, C.B.E., on the flying aspect of these contests and by a general discussion. Admittance will be free but contributions towards the charge for the use of the room will be gratefully received at the door at the conclusion of the proceedings.

* * *

FOR the three months July, August and September the total hours flown at the Darlington and District Air Centre amounted to 450. One of the youngest members of the Club, Mr. Bond, recently went solo after only five hours of dual instruction. Croft Airfield has recently been granted a licence by the Ministry of Civil Aviation. The Darlington Club is now in a position to offer full renewal services, C. of A. and major overhauls. The Club lounge is open to all visitors by air and meals and overnight accommodation can be arranged. The social side of the Club is very active, the fortnightly dances proving a great success and the film shows are attracting a good attendance.

* * *

JOINTLY operated by B.O.A.C., B.E.A. and B.S.A.A., the Airways Aero Club has commenced operating from Denham Airfield and is open to members of the three Corporations. The entrance fee is one guinea and the weekly subscription of 1s 6d (or for social members 6d) can be deducted from employees' salaries. Flying charges are £1 per hour in the two-seater side-by-side Aeroncas, while for Austers, Tigers and Magisters the charge is 30s per hour. Temporary club premises with the usual facilities will shortly be ready and in the initial stages there will not be accommodation for more than 400 members in the London area; full particulars, application forms and books of rules may be obtained from the Secretary for B.E.A., Mr. C. F. Stubbs, at Northolt.

* * *

MEMBERS of the Wirral Aero and Gliding Club completed 410 hours flying at Hooton Park during the months of July, August and September, during which period 12 "A" licences were obtained. At the Auster Rally at Rearsby the Club provided three Austers and a Gemini for joy-riding and in the course of the Battle of Britain Day celebrations Club aircraft offered flights to the public at Sealand, Hooton Park, Waddington and Cottesmore. The membership now totals 200 and up to date a total of 98 "A" licences have been obtained. From November 1st for a period of three months flying rates of £2 per hour are being offered and it is hoped that this will help to keep club flying alive during the winter and bring flying within the reach of a wider section of the public.

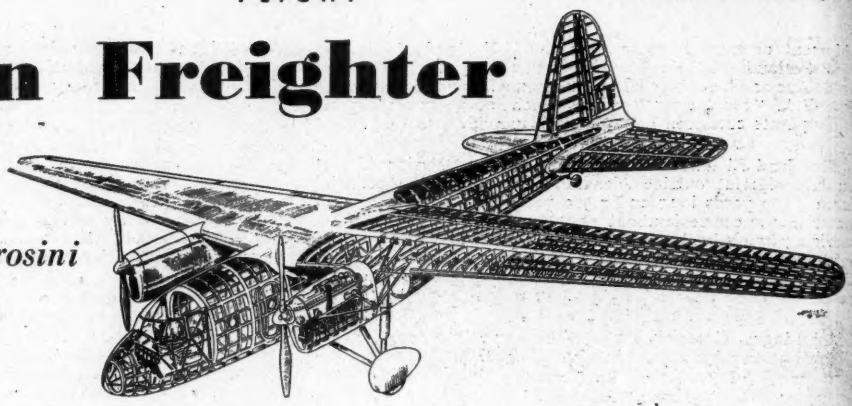
* * *

THE summer season has been a busy one for the Weston Aero Club who have completed nearly a thousand hours' flying. It is claimed that they have the youngest and the oldest active pilot members in a flying club, whose ages range from 17 to 70 years. A recently joined member enthusiastically announced that he had bought a Proctor V, having made his first dual flight a few days previously; after a total of 35 hours solo on the Club's Auster and Fairchild he was able to manage his own aircraft satisfactorily single-handed. The President of the Club, Mr. G. M. B. Bennett has presented a silver cup to be competed for annually. This was won by Mr. W. P. Jones who was successful in both a spot landing competition and a snag finding test which caused much amusement and interest amongst members. In conjunction with the *Weston Gazette* the Club also organized a flight scholarship competition which proved most popular. Next year two more such scholarships will be offered. The Club's first annual ball was held at the Winter Gardens on September 17th and was attended by about 320 members and their friends. The evening was a great success and next year's event is being looked forward to by everyone.

NORTHERN HEMISPHERE CIRCUIT: Mrs. Richard Morrow-Tait leaving her Proctor after arriving at Haneda Airfield, Tokyo, nearly halfway on the flight around the world. The following day she and her navigator, Mr. Michael Townsend, took off for the next stage, to the Aleutians, escorted by a B.17 U.S. Air Force air-sea rescue aircraft.

Italian Freighter

The S.A.1—Ambrosini P.512 Twin



SINCE the revival of commercial flying in Italy, a considerable amount of initiative has been shown in the field of domestic air transportation, and a comprehensive internal airline network is in process of formation. It is hoped that this network will present none of the shortcomings characteristic of pre-war domestic services operated in Italy. At the present time, a miscellany of aircraft types are in service, not all of which are ideally suited for short-haul internal services. Thus, it is natural that many Italian operators are looking for an economical "workhorse" aircraft with which to replace present equipment. To fulfill this requirement, the S.A.I.-Ambrosini concern of Milan is constructing the prototype of a light freighter, the P.512, intended primarily for short-haul internal services.

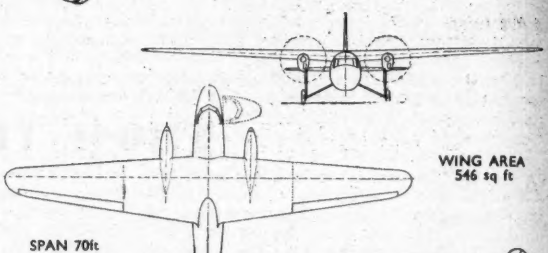
Designed by Ing. Ermenegildo Preti, the P.512 is a direct development of the AL.12P cargo-carrying glider produced by Aeronautica Lombarda during the later war years. Power is provided by two Alfa 115 ter six-cylinder in-line inverted air-cooled engines, each of which produces 225 b.h.p. for take-off and drives two-blade, metal, v.p. airscrews. Other engines in the 200-250 h.p. class (i.e., the Gipsy Queen 30) could be installed. The P.512 retains all the constructional features of the AL.12P glider, including the nose section which hinges to starboard, facilitating the stowage of bulky freight.

Basically, the P.512 is a twin-engined high-wing cantilever monoplane primarily of wooden construction. The high-aspect ratio wing is of monospar construction and is built in one piece. An auxiliary rear spar carries the flaps and ailerons. The main fuselage section is an all-wood semi-monocoque structure of elliptical section.

A departure from the otherwise all-wood structure is the fuselage nose section which has a metal tubular frame covered by plywood. This section provides accommodation for a crew of two in side-by-side seats and hinges to starboard to give access to the cargo compartment. This compartment has a capacity of 494 cu ft, and the length that can normally be used is 21ft 3½in. The height is 5ft 6½in and the width 4ft 11in.

The undercarriage is fixed and the steerable tail wheel has an oleo-pneumatic damper and automatically returns to the central position.

In order to facilitate loading operations the fuselage is fitted with a small tackle to drag bulky packages along the inclined floor of the cargo compartment. Rings are provided on the floor and compartment walls for making the load fast.

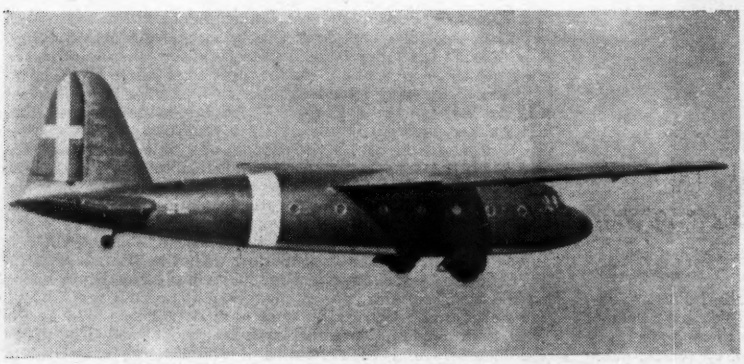


The lever which controls the opening of the fuselage nose is adjustable from the cockpit and is so placed that flight controls cannot be moved unless the lever is in the closed position.

Main dimensions, weights and loadings are as follows: Span, 70ft; length, 46ft; height (tail down) 11ft; wing area, 546 sq ft. Empty weight, 4,410 lb; gross weight, 7,937 lb; useful load 3,527 lb. Wing loading, 14.5 lb/sq ft; power loading, 17.6 lb/h.p.

Performance: Maximum speed at sea level, 155 m.p.h.; cruising speed, 143 m.p.h.; minimum speed without flaps, 60 m.p.h., and with flaps, 53 m.p.h. Rate of climb at sea level 970 ft/min. Ceiling on one engine, 6,900ft. Range with a payload of 2,810 lb, 310 miles; with a payload of 1,650 lb, 1,240 miles.

W. G.



A.L. 12 P. glider from which the freighter has been developed.

SWEDISH SIX-YEAR PLAN

A SIX-YEAR plan to increase the strength of the Swedish Air Force has been submitted to the Ministry of Defence but has yet to receive the approval of the Swedish Government. The increases now proposed in the strength of the existing number of Wings are additional to the increases in the overall strength of the Air Force approved and made, or in hand.

The ten existing Day Fighter Wings, now of normal strength, are to be enlarged by 50 per cent. Approval to increase the strength of three of the Wings has already been granted. One of the four existing Day Attack Wings is to be converted into a Night Fighter Wing, thereby providing two Night Fighter Wings, and as compensation for the Day Attack Wing, thus withdrawn, two of the remaining three Attack Wings will be strengthened by 50 per cent.

To cover the most important areas of Sweden it is necessary to have at least 13 Day Fighter Wings, but with only ten Wings some parts of the country will be left without adequate defence by the Air Force. Strengthening of the Wings by 50 per cent will give each increased power and mobility within the areas that must be covered.

Without extraordinary measures, such as buying from abroad the proposed increases in the strength of the Air Force should be completed within six years at a cost of about 240 million Swedish crowns.

PART TWO

POWER PLANT INSTALLATIONS

PRESENT DAY ARMAMENT

FIGHTERS

BY H. F. KING, M.B.E.

IN the field of propulsion, it is evident that airscrew-driven—certainly piston-engined—fighters will have become almost extinct within a few years, though some multi-purpose machines, which may be called upon to operate in a heavy-fighter or intruder role (e.g., the Westland Wyvern), will continue for a time to be powered with turboprop units driving high-efficiency airscrews. These types may attain maximum speeds of 500-600 m.p.h. Composite power plants, exemplified by the turbojet-turboprop combinations in the Ryan XF2R-1 and Convair XP-81 (both now abandoned) may also be specified for some aircraft of the class, but the general demand for speeds in excess of 600 m.p.h. will render imperative the exclusive use of "straight" jets.

That turbojet units will be of both radial and axial-flow design is not to be doubted when current technical development and known fighter projects are considered. A single radial unit lends itself especially well to fuselage installation and will be common in "general-purpose" fighters, and possibly in intercepters. Particularly attractive for the latter application are the high thrust/weight ratios now promised. Vertical-climbing turbojet intercepters of 6,000-7,000 lb all-up weight with a thrust/weight ratio of 1:1 are a possibility of the immediate future. Where greater power is demanded—e.g., in the Lockheed XF-90, Republic XF-91 and Consolidated-Vultee XF-92 supersonic intercepters—liquid-fuel rockets may be adopted in preference to, or even in addition to, thrust-augmentation by tail-pipe after-burning, water-methanol injection, "jet injection" (convergent divergent nozzles in the tail pipe), and auxiliary burners. Employment of any of these expedients—for they are nothing more—may go far to redeem one of the present shortcomings of the turbojet, namely, its dependency upon forward speed. The rocket unit, or units, can be applied directly to the airframe, or, as in the case of the German BMW003R, may be incorporated with a turbojet.

The low frontal area of the axial-flow turbojet and its potential fuel economy render this type of power plant specially suitable for "penetration" and night-and-all-weather fighters. With two axial-flow units mounted close to the centre-line, it will be feasible to cruise economically on the power of one, reserving the second for take-off, climb, combat and emergency.

Though ram jets, or athodyds, have been applied to a number of fighters during the past four years, the installations have been wholly experimental—more with a view to determining operating characteristics than to development for military use. Ram jets are now foreseen as supersonic power plants, whereas present-day turbojets are efficient only at subsonic speeds. The liquid-fuel rocket, by its very nature, is suitable only for short-range fighters and for supersonic operation and it may be necessary to retard the intake air of turbojets to subsonic speed, or to utilize compressors capable of efficient supersonic operation. The turbojet adapted for tail-pipe after-burning (when the combined unit becomes, in effect, a "turboramjet") is an attractive possibility for supersonic flight.

The McDonnell XF-85 Parasite, designed to be carried by the Brabazon-sized B-36 bomber for its protection

For the present, the principal installation problem associated with turbojets is the provision of efficient ducting, without prejudice to accessibility, replacement, tankage and armament. Ducting, and other power plant considerations have necessitated in many instances a multiplicity of small fuselage tanks, intricate in design and inaccessibly disposed. The least tractable airframe layouts from the standpoint of fuselage tankage are those calling for curved lengths of duct, whereas the most favourable are those which leave the fuselage more or less free of power plant impediments. Typifying these latter is the McDonnell Banshee, with twin axial-flow turbojets installed in thickened wing roots and, of course, the Gloster Meteor and Me 262 with outboard units.

With a single-jet design, unless the power plant is mounted externally (e.g., He 162), it is normally necessary to devote a very large proportion of available room to the turbojet, with its associated ducts and tanks. This necessity, and the desirability of reducing tail-pipe length to a minimum, led

to the development of the Hawker "bifurcated-duct" system, with the twin jet pipes exhausting at the wing roots and permitting an unusually large internal tankage forward and aft of the Nene turbojet. In conjunction with wing-mounted auxiliary tankage, this internal provision is claimed to permit a range comparable with that of the piston-engined Sea Fury (2,000 miles). It is possible that wing-tip fuel tanks, similar to those developed for American jet fighters will be used on the new Hawker fighter instead of the more usual "slipper" or "pylon" type. The wing-tip location is claimed to reduce the drag increase at high speed; increase the effective aspect ratio, by providing an "end plate" effect; minimize the adverse effect of external tanks on critical Mach Number; and simplify the jettisoning problem. The centred position on the wing tip, as used on the Thunderjet, was not adopted for the Shooting Star because of the inability to carry existing bombs in this manner. A better dihedral effect is provided by the centred position.

Indicative of what can be accomplished in some designs to facilitate power plant inspection and change is the detachable rear fuselage as incorporated in the Shooting Star and Thunderjet. In the former instance the turbojet unit can be replaced in 20 minutes, and in the latter, 50 minutes.

Power plant and tanks having been positioned, the cockpit and armament must be located to the best advantage. One of the most gratifying qualities with which modern jet fighters have been endowed by the turbojet is that of a wide field of view, resulting from the forward position of the pilot's or crew's compartment. An exception is the Russian single-jet Yak with an underslung jet unit—a design which appears to possess simplicity as its principal, if not sole, merit. "Blown" canopies of good aerodynamic and optical qualities are now being standardized, that of the Hawker N.7/46 being the most notable British example

FIGHTERS

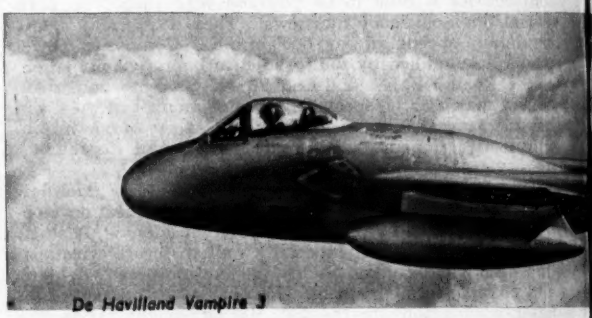
to date. It will be appreciated that as speeds increase, breadth and clarity of vision assume greater importance, and it is regrettable that the "delta" wing layout threatens to prove retrogressive in respect of view.

Hardly less important to the pilot than an adequate field of vision is his physical and mental composure. Jettisonable cockpit canopies, now standardized as a safety measure, themselves may represent a danger under certain conditions. Design will be greatly complicated if a completely jettisonable crew section, as already incorporated in the Douglas Skystreak and Skyrocket, is specified. (With this arrangement, the pilot, having jettisoned himself with a portion of the fuselage, remains seated until that protective structure has decelerated sufficiently for him to bale out in the ordinary manner.)

If the pilot is to fight his aircraft to the limit of his capabilities, he must not be cramped by inadequate leg or head room, or incommoded by bad positioning of instruments, switches and controls. Pressure cabins are already normal. Ejector seats, temperature control, ribbon-type "high-speed" parachutes and "bale-out" oxygen equipment are becoming the order of the day, and g suits will be increasingly worn if the physical limitations of the crew are to approach nearer those of the airframe. Accelerations of 6-8g are commonly experienced in service, and at least one test pilot has held 9g throughout a 360-degree turn. Possibly the highest factor yet recorded (unintentionally, be it said) stands to the "credit" of a Shooting Star pilot who applied 11.3g during air-to-ground firing trials.

The astonishingly rapid and significant progress achieved in the aerodynamic and structural design of fighter aircraft is sharply contrasted with the apparently sluggish evolution of armament. So leisurely has been the course of armament development in Great Britain that it has become our custom to watch progress abroad and to acquire the manufacturing rights for weapons and devices of special merit. Thus, in succession to the Lee-Enfield rifle (basically a foreign design) our fighting airmen have been armed with the Lewis, Vickers (Maxim patent), Browning and Hispano guns, while the design of some of our finest power-operated turrets has been based on foreign patents. Happily the technicians charged with the development of Britain's air armament have shown a particular flair for applying and adapting foreign material; it is sincerely to be hoped, however, that the acquisition of a sizeable armoury of German air ordnance (including numerous experimental and semi-experimental guns and other weapons for the arming of fighters) will serve only to stimulate, and not

Grumman XF9F-2 Panther

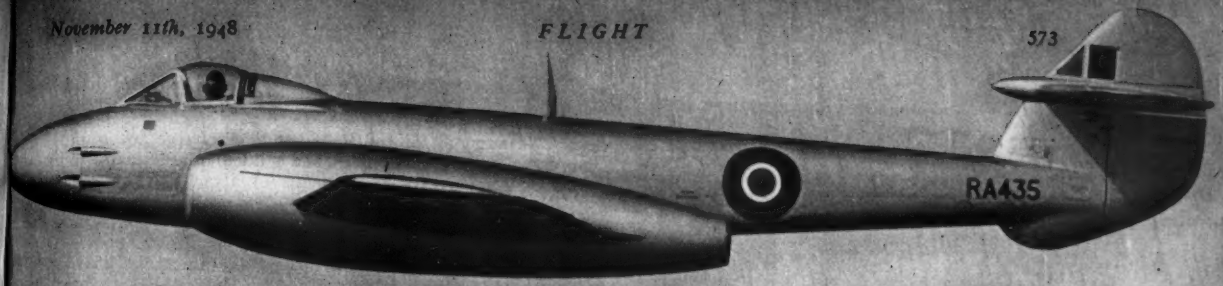


De Havilland Vampire 3

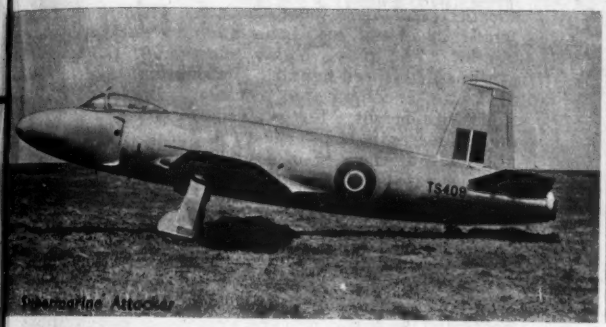
North American F-86A

to mesmerize, these Ministerial and Service authorities.

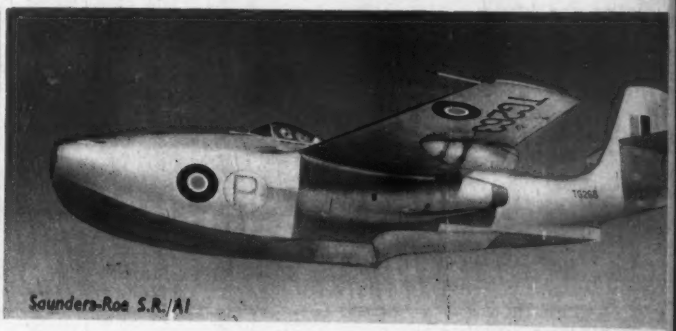
Britain's present policy in the arming of fighters is simply stated by the familiar and, be it said, well proven formula "4 × 20 mm," the efficacy of which was vastly increased during the war by our perfection of the gyro gunsight. America (whose "fifty calibre" Colt-Browning gun has assumed something of the legendary character of the Kentucky rifle), has shown less inclination to fall into line with Great Britain and other countries, where guns of 20 to 23 mm calibre are standard equipment. The U.S. Navy has, in fact, lately put into service in the Grumman Bearcat and McDonnell Banshee, a gun of 0.6 inch bore which, while having a somewhat slower rate of fire than the 0.5



Gloster Meteor 4



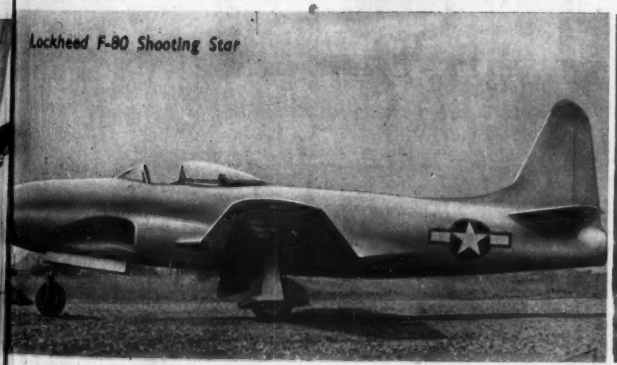
Supermarine Attacker



Saunders-Roe S.R./A1

Gloster E.1/44

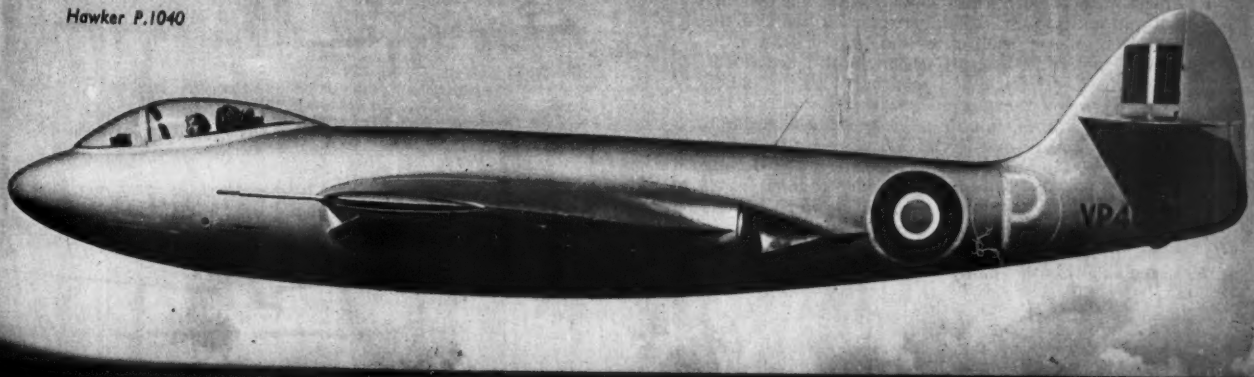
SAAB J-29

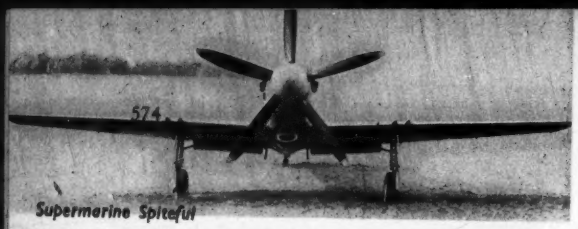


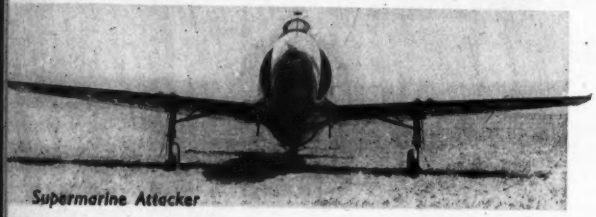
Lockheed F-80 Shooting Star

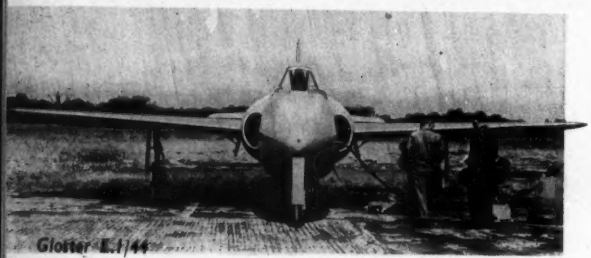
Republic F-84 Thunderjet

Hawker P.1040




Supermarine Spiteful


Supermarine Attacker


Glotter E.1/44

De Havilland Vampire

FIGHTERS

launcher for the R4M would discharge 300 rounds a minute. Air-launched guided missiles are being investigated as a means of attacking the larger aerial targets.

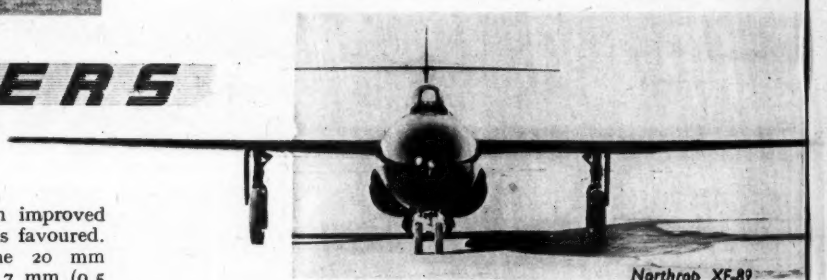
Automatic firing, initiated by radar contact, or on the photo electric principle, is already possible.

Two factors which have an important bearing on fighter armament to-day, but which are not, perhaps, widely appreciated, are, first, the additional velocity and flatter trajectory imparted to a projectile by the speed of an aircraft (600 m.p.h. = 830 ft/sec) and, secondly, the further flattening of trajectory at great heights due to the decreased density of the air. Thus, a gun which in ground-test installation might appear inferior could prove highly effective in a high-altitude high-speed fighter. The sighting problem, of course, is complicated by these ballistic variations with height. For a given set of conditions an increase in muzzle velocity is generally attainable only at the cost of a greater weight of gun and decrease rate of fire.

Armouring

Armour protection, in the form of steel or laminated dural plate, will continue to be afforded to an extent which will be governed by considerations of weight and performance, but the jet fighter is by nature a very vulnerable target, if only by reason of its proportionately large tankage.

For the attack of ground targets—a duty for which the majority of jet fighters are well suited due to their high performance at low levels and the unusually wide field of view they afford—a load of bombs or rocket projectiles is readily carried. Two 500-lb or 1,000-lb bombs, or 8-10


Northrop XF-89

Lockheed F-80 Shooting Star

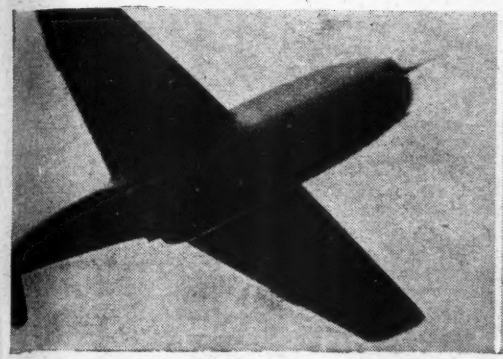
Republic F-84 Thunderjet

North American FJ-1 Fury

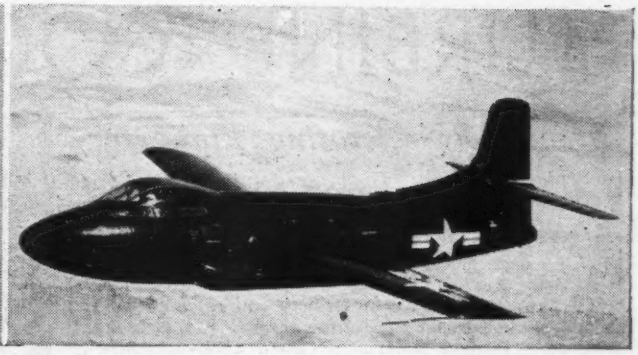
inch, is reputed to develop the extremely high muzzle velocity of 3,300 ft/sec. In the U.S. Army an improved M-3 gun (0.5in), firing 1,200 r.p.m., is favoured. Russia continues to supplement the 20 mm Sh-VAK guns of her fighters with 12.7 mm (0.5 inch) weapons. Guns of 37 mm calibre have also been fitted on a limited scale.

Installation Problems

Fuselage installation of armament is now standard practice, a notable exception being the Supermarine Attacker with four 20 mm wing-mounted Hispanos. Advantages of the fuselage layout are concentration of fire, simplification of heating and control, and avoidance of the distortion which may be incurred by a wing under high accelerations. The problems attending the "burying" of a battery of guns in a relatively slim fuselage, and those arising from recoil, muzzle blast, the corrosive propellant gases, the feeding of ammunition during violent manœuvres and the ejection of used shell cases and belt links, are the joint concern of aircraft designers and armament specialists. These latter, together with the ballisticians, are further occupied with determining the optimum calibre, muzzle velocity, rate of fire and type of fusing for given purposes, reconciling calibre of ammunition with quantity, developing improved sights, and assessing the advantages of guns as compared with rocket projectiles. As applied to fighters for air-to-air use, R.P.s are exemplified by the German R4M, and require special automatic launching devices. The RA55



A Mig fighter of the Soviet Air Force. It will be seen that the twin axial-flow turbojets are underslung.

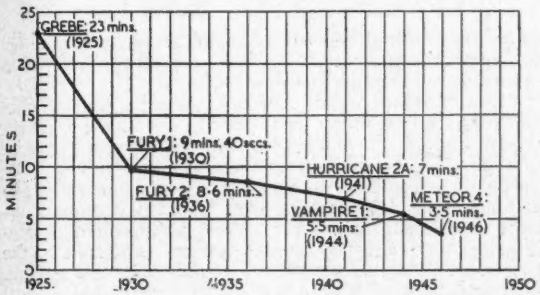


The deck-landing Douglas XF3D Skyknight, a new twin-jet night-and-all-weather fighter for the U.S. Navy.

Fighters . . . . .

R.P.s are typical loads, supplemented by the fire power of the built-in armament. Some troublesome installation and launching difficulties have arisen from the high speeds attained. On the Lockheed Shooting Star, for instance, the tail fins of bombs carried in place of the more usual auxiliary tanks at the wing tips, were unscrewed by vortices. Pins through the threads, inserted as a safeguard, were sheared. On the Thunderjet, the R.P. mountings retract automatically into the wing when the projectiles are discharged.

The remarkable versatility of current jet fighters in no way modifies the view expressed in the first part of this survey that "general purpose" fighters will be increasingly handicapped when matched against more specialized machines.



Graphic illustration of improvement in the time of climb of British fighters to 20,000ft.

INCREASE IN FIGHTER SPEED (GT. BRITAIN)

Year	M.p.h.	Aircraft.
1920	121	SOPWITH SNIPE
1925	152	GLOSTER GREBE
1930	207	HAWKER FURY I
1935	255	GLOSTER GLADIATOR
1938	340	HAWKER HURRICANE
1940	367	SUPERMARINE SPITFIRE I
1942	400	HAWKER TYPHOON
1944	500+	DE HAVILLAND VAMPIRE
1945	585	GLOSTER METEOR 4
1947	600+	HAWKER N.7/46
1948	650	?

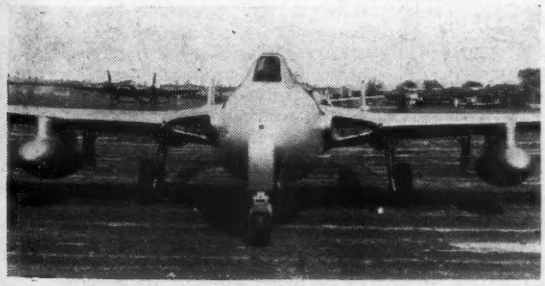
VAMPIRES FLY FAR

ALMOST weekly some new achievement by the de Havilland Vampire jet fighter is announced. This week, two significant non-stop flights must be recorded—one from Hatfield to Rome on November 4th, and another between Shjarah and Khambalia on the previous day.

For the trip to Italy the pilot was Mr. John Derry, who covered the 916.1 miles from the de Havilland airfield to the Ciampino airport, Rome, in 2 hours 50 min. 40 sec., departing at 09.43.28 G.M.T., and arriving at 12.34.08. His average speed was thus 323 m.p.h. The Vampire, which is to be demonstrated in Italy, had been delayed since November 1st by weather and was flown over the greater part of the route at 25,000-30,000ft.

The second flight was the last stage of a 6,000-mile delivery trip from England to India by three Vampires for the Government of India. The distance between Shjarah and Khambalia is 960 miles, approaching the maximum range of the Vampire (1,145 miles) with its standard long-range tankage of 530 gallons.

These two flights provide further evidence of the qualities of the Vampire and of the ability of the best jet fighters to remain aloft far longer than the 45 minutes which is still considered by a surprising number of people to approximate to the limit of safe endurance.



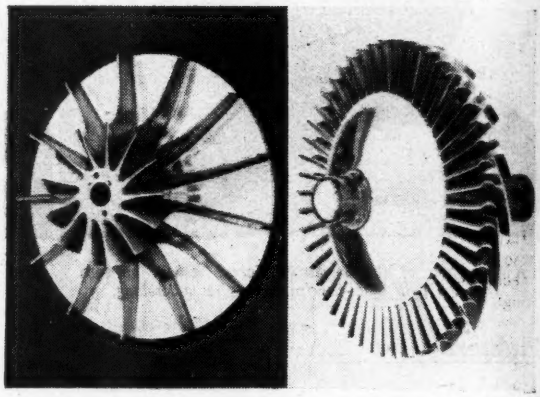
A Vampire 3 with auxiliary tanks which are supplied as standard for optional fitting.

R.Ae.S. AND I.A.S.A. CONFERENCE NEXT YEAR

NEXT year's Anglo-American Aeronautical Conference, the objects of which are the consolidation and continuance of the cordial relations between the Institute of the Aeronautical Sciences of America and the Royal Aeronautical Society is planned to take place in New York City between May 22nd and June 6th, 1949. On a recent visit to London the Institute's representative, Mr. A. D. Emil, handed to the Council of the R.Ae.S. an invitation to designate representatives to attend in which was stressed the importance of periodic interchanges of technical views between the two societies to the advancement of aeronautical sciences. The president and Council of the R.Ae.S. have accepted this invitation, which includes visits to aircraft firms and airfields. The previous Anglo-American Aeronautical Conference was held in London in September, 1947, and members of the Society who propose to attend the forthcoming event should inform the secretary as soon as possible.

TURBINE COOLER UNIT

Airborne Refrigerating Plant for Cabin Atmosphere Conditioning



Left : The 13-blade compressor is 6 3/16 in in diameter and employs separate axially-curved inlet blading. Right : The turbine wheel is 5 7/16 in in diameter, has 50 blades and is fed through a 17-slot infuser nozzle ring.

WHAT a good thing it is that, even whilst such an immense event as political revolution is taking place, the minds of men can be concentrated on smaller but not, in terms of ultimate values, necessarily less important things. During the turmoil of the French Revolution, Jacques Alexandre Césare Charles, mathematician and physicist, had the qualities of mental impatience and perception which led him to anticipate Gay-Lussac's definition of the dilatation of gases with heat. Thus, what we now know as Charles' law states that "at constant pressure the volume of a gas increases by equal amounts with equal increments of temperature." It is on this fundamental precept, and its consonant reciprocals that change of any one of the quantities concerned will bring about change of the other factors, that the Marshall air-cycle turbine cooler unit described in this article operates. By changing the volume of air through compression and expansion, the temperature is caused to change correspondingly.

In the early stages of cabin conditioning there was a widespread tendency to regard it as a relatively simple sideline, but with the passing of time it has become increasingly apparent that the furnishing of a fool-proof, completely reliable pressurizing and conditioning system in an aircraft is a vastly difficult matter. The complex system of forcing air into the cabin and appropriately cooling it, heating it, drying it or wetting it, is a modern necessity. Certainly, all these conditional processes are not required simultaneously, but the system must embrace them all, so that they may be called upon as and when occasioned by a flight from one climatic region to another.

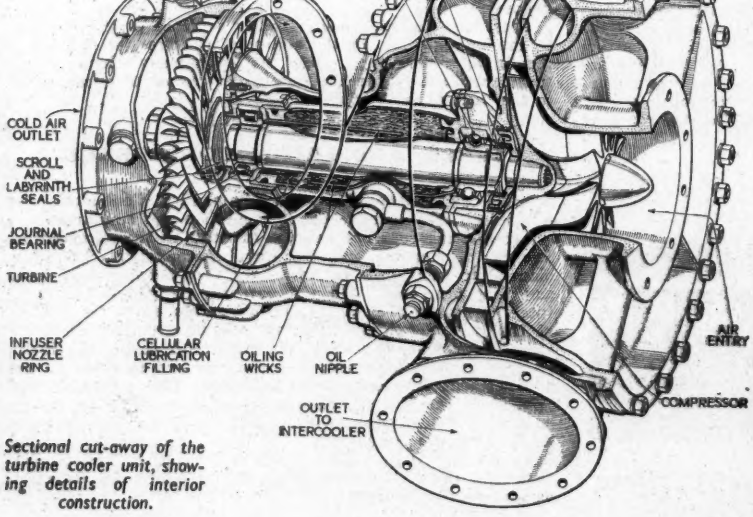
Conditioning Flow Sequence

The basic cabin air-conditioning system has been described so frequently in the past, both as an entity and in conjunction with aircraft descriptions, that reiteration would be pointless. Nevertheless, the latest ideas on the subject have introduced sundry modifications, and, in order to clarify the present state, it is, perhaps, worth while briefly to run through the flow sequence.

Air is entrained usually through the wing leading edge and passes through filter units prior to entering the engine-driven blowers. From these, the air successively goes through silencers, spill valves and non-return valves, to be unified in a common duct in the aircraft fuselage. The accompanying diagrammatic plan layout of a typical aircraft installation defines the general arrangement of conditioning units and the arterial system. Adjacent to the lead-in trunk is the mass-flow metering unit, downstream of which the duct is branched, (i) to a choke heater unit and, (ii) to the primary intercooler. The choke heater is a new development and is intended to raise the temperature of the cabin air by choking the blowers and thus making them work harder so that the temperature of the air they deliver is increased. It has been established that the heating obtained in this manner is quite sufficient for all normal purposes. When heating is not required, coupled by-pass valves in the duct branches direct the airflow through the primary intercooler and close off the choke unit.

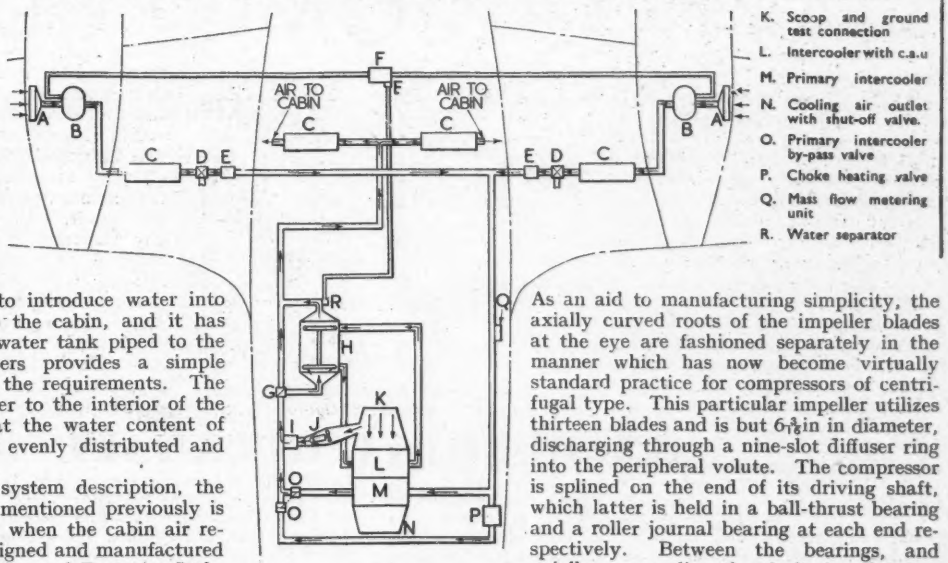
For the convenience of installation, the primary and secondary intercoolers, each of which is a simple air-to-air heat exchanger, are arranged side by side in a ram duct into which the "coolant" air is scooped, passed through the intercoolers, and exhausted back to atmosphere.

On emergence either from the choke heater or the primary intercooler, the air is delivered to a by-pass valve which, accordingly as heating or cooling is required, directs flow respectively to by-pass or to feed the turbine cold-air unit. Downstream of these components, the duct once more branches into a pair of separate silencers prior to delivery to the cabin. Before going on to describe the cold-air turbine unit, mention should be made of the means of introducing humidification. When flying in conditions of low ambient humidity, it



Sectional cut-away of the turbine cooler unit, showing details of interior construction.

DIAGRAMMATIC LAYOUT OF TYPICAL CABIN CONDITIONING SYSTEM



may be necessary to introduce water into the air supplied to the cabin, and it has been found that a water tank piped to the engine-driven blowers provides a simple method of meeting the requirements. The introduction of water to the interior of the blowers ensures that the water content of the air delivered is evenly distributed and finely atomized.

As noted in the system description, the turbine cooler unit mentioned previously is brought into action when the cabin air requires cooling. Designed and manufactured by Sir George Godfrey and Partners, Ltd., the unit is a beautifully constructed little component which, for a weight of 21 lb, and without requiring any source of ancillary power, will do a job of refrigerating work which might be enviable in a bulky commercial system. At first sight it appears as though, in operation, something for nothing is being obtained, but in point of fact, it is the energy abstracted from the air in terms of heat which provides the source of power for driving the unit. Briefly, the incoming air is fed to the eye of a small single-sided centrifugal impeller, where it is over-compressed (relative to the cabin pressurizing requirements) and delivered from a volute scroll to the secondary intercooler. On leaving this last the air re-enters the cold-air unit and is led to a miniature turbine through which it expands into the normal duct system for delivery to the cabin. It is by expansion through the turbine that the temperature of the air is greatly reduced, and the energy thus imparted to the turbine is used to drive the centrifugal compressor.

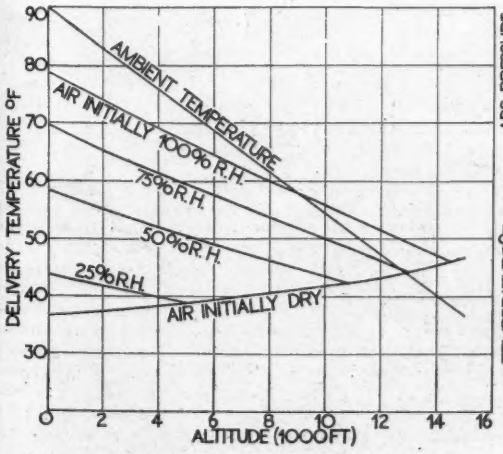
The unit is very compact—it measures only 10in in diameter—and, as may be seen from the cut-away drawing, the light-alloy casing is in four parts, viz., the entry mouth and diffuser face, the compressor volute trunk, the re-entrant infuser trunk and the turbine shroud and outlet.

As an aid to manufacturing simplicity, the axially curved roots of the impeller blades at the eye are fashioned separately in the manner which has now become virtually standard practice for compressors of centrifugal type. This particular impeller utilizes thirteen blades and is but 6⅞in in diameter, discharging through a nine-slot diffuser ring into the peripheral volute. The compressor is splined on the end of its driving shaft, which latter is held in a ball-thrust bearing and a roller journal bearing at each end respectively. Between the bearings, and axially surrounding the shaft, is a lubrication chamber filled with a celluar wadding in which are embedded wicks serving the shaft bearings. Conventional synthetic-rubber seals enclose each end of the lubrication chamber, and complementary seals on the opposite sides of the bearings are of labyrinth type, vented to the dead air space inside the central casing. The lubrication chamber is served by an oil-way from a nipple housed in the outer casing.

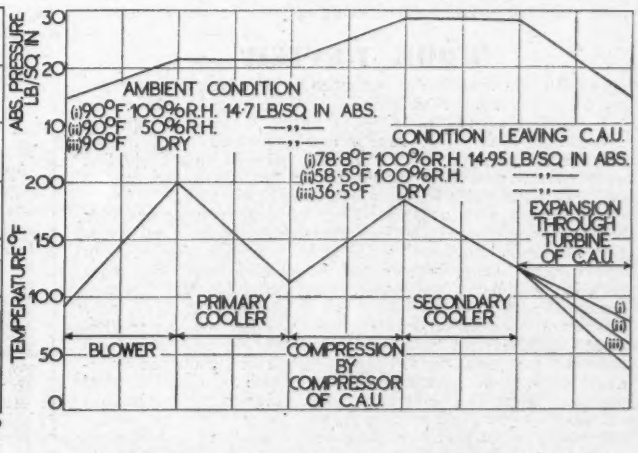
Turbine and Operational Details

Similarly splined on the opposite end of the drive shaft, the turbine wheel is particularly interesting in that it is machined from a solid blank. The blading is axially constant, that is to say there is no "twist," and the blade chord is symmetrical from root to tip; a crescent section is employed so that the blading can be described as being of bucket form. Although not apparent from the drawing, the turbine disc is actually of dished type, this design detail contributing to the compactness of the unit's overall length.

At its normal operating speed of 24,500 r.p.m., the delivery capacity of the cold-air unit is 54 lb of air/min. Supply from the engine-driven blowers is made at a pressure of 6.5 lb/sq in and the compression ratio of the unit's



Curves of delivery temperature against altitude for varying ambient relative humidities.

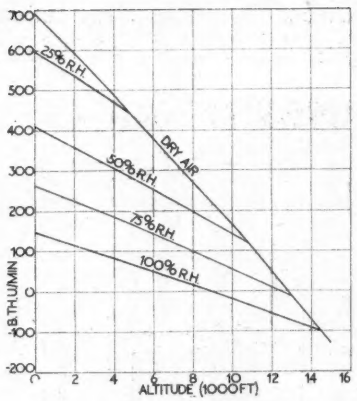

ABS. PRESSURE LB/SQ IN
TEMPERATURE °F
AMBIENT CONDITION
(i) 90°F 100% R.H. 14·7 LB/SQ IN ABS.
(ii) 90°F 50% R.H. —,,—
(iii) 90°F DRY —,,—
CONDITION LEAVING C.A.U.
(i) 78·8°F 100% R.H. 14·95 LB/SQ IN ABS.
(ii) 58·5°F 100% R.H. —,,—
(iii) 36·5°F DRY —,,—
EXPANSION THROUGH TURBINE OF C.A.U.
PRIMARY COOLER
SECONDARY COOLER
BLOWER
COMPRESSION BY COMPRESSOR OF C.A.U.

Temperature and pressure sequence of flow between intake and cabin with delivery conditions for given ambient conditions.

Turbine Cooler Unit . . .

own centrifugal blower of 1.35:1 gives a pressure drop across the turbine of 13.65 lb/sq in.

From the performance curves, the work done by the unit, and its specific capabilities, can be ascertained graphically. In conditions of high relative humidity, excess water will be condensed out of the air leaving the turbine unit by passing it through a combined water collector and silencer fitted immediately downstream of the cold-air unit. As an example, with air inducted at an ambient relative humidity of 75 per cent, it is likely that, when the air leaves the turbine, its relative humidity will be in excess of 100 per cent and, of course, whatever the excess percentage happens to be will need to be bled away. In addition, air pumped into the cabin at 100 per cent relative humidity will have to do a job of cooling, and this means the abstraction of heat. The effect is that, as heat is abstracted, the relative humidity in the cabin will fall and thus give a cabin atmosphere well within the comfort range.



Curves of cooling load against altitude for varying conditions of relative humidity.

Relative humidity is the percentage quantity of water vapour present in the air in comparison with the saturation point, i.e., the point at which any reduction in air temperature will result in the precipitation of moisture, saturation occurring when the air is holding the maximum amount of water at any given temperature.

Whilst, in this article, we have dealt only with the 54 lb/min capacity unit, a range of larger units of essentially similar design is available.

AN HOUR AT HUCKNALL

IT is remarkable how much can be seen and learned on even the briefest tour of the Rolls-Royce establishment at Hucknall. A knowledgeable guide, accustomed to expounding lucidly and concisely the most obscure technicalities is, of course, invaluable, and the writer was fortunate in being accompanied by just such a man in the person of Mr. J. P. M. Reid, one of the pilots engaged on research flying.

Since the work of Hucknall was surveyed in *Flight* on January 22nd and 29th this year, the flying staff has increased, and some duties have been re-allocated. Seven pilots, under Captain R. T. Shepherd, are responsible for development flying, and another four, headed by S/L. H. N. D. Bailey, are engaged on research flying and liaison with the Services. An adjutant compiles pilots' notes on the operational characteristics of engines, which form the basis for sections of relevant Air Publications. Observations and criticisms advanced by the Rolls-Royce pilots as a result of their liaison with Service units can affect to an important extent the flying policy of the Services.

The aircraft at the disposal of the Rolls-Royce research and development organizations themselves constitute quite a formidable military force. Three Meteors (Derwent 5s) are available for endurance tests and for the investigation of burners and oil systems. A Hornet (two Merlins) is engaged on high-altitude flying, with particular reference to supercharger surge, and a Naval Firefly has been the subject of a most profitable investigation of the economies latent in low-power engine operation at reduced r.p.m. The range of Griffon-engined Naval aircraft has lately been increased by as much as 30 per cent as the result of this research.

One saw the Dart-Wellington which served for exploratory flying before the Vickers Viscount took the air, an Eagle-engined Westland Wyvern Naval strike fighter, the now historic Trent-Meteor, the Dart-Lancaster, the Avon-Lancastrian, the Nene-Lancastrian and another Lancaster, newly adapted for the installation of four Griffons. On this last machine, the inboard units are power plants for the Avro Shackleton long-range maritime reconnaissance aircraft; outboard are standard Griffons undergoing endurance tests. A new Seafire 47 is being prepared for the testing of aluminium radiators which offer a weight-saving of 200 lb on a Griffon installation. One expressed surprise that these radiators should not have been tested in a complete power plant rather than under the wings of a fighter. The explanation was soon forthcoming that the Seafire offered the best means of "caning" the radiators. Full-power climbs will be made to ceiling, to be followed by engine-off glides to low altitude.

A visit on October 29th by the Vickers Viscount was an event of special interest to the Hucknall staff, and to Rolls-Royce directors and technicians, who took advantage of Captain Mutt Summers' invitation to experience the totally new sensation of flying in Britain's first turboprop transport. The quiet of the cabin and the handling qualities of the aircraft drew special praise from Mr. E. W. Hives, managing director of Rolls-Royce, and from Mr. R. N. Dorey, chief development engineer, who remarked to the writer that he plainly heard the undercarriage and flaps retracting. Mr. Dorey's only concern was that the lack of noise and vibration during a steep climb might indicate that the aircraft was on the point of stalling. To reassure himself, he went forward: the "clock" showed an ample 130 knots.

An Avro Tudor VIII with four Nenes should be delivered to Hucknall within a few weeks. Meantime, valuable experience with the Nene is being gained in a Vampire airframe, the intakes of which have been completely re-designed to suit the characteristics of the power unit. These intakes—known at Hucknall as "diffusing" intakes—decrease the velocity of the incoming air to gain pressure for the plenum chamber. Little or no change in the critical Mach Number of the airframe has been noted.

BOOK REVIEW

Jane's All the World's Aircraft, 1948. *Sampson Low, Marston and Co., Ltd. Price three guineas.*

"LOOK it up in *Jane's*" is a phrase which, through the years since 1909, has become household usage in the aviation community. Each annual issue of this unrivalled work of reference is a monument to the thoroughness and vigilance with which its compilers tackle their task.

Conforming with usual practice, the 1948 volume has four main divisions, of which three (Service Aviation, Civil Aviation and Aero Engines), while strictly outside the scope of the title, are comprehensive and valuable as ever. The main Aircraft section is unusually large; in fact, Mr. Leonard Bridgman, the editor, points out in hs preface that this is only the second occasion on which it has exceeded 300 pages. Research discloses that the aircraft section of the 1945-46 edition occupied 315 pages, at a time when the newly opened floodgates of wartime security released a rush of semi-historical material rightly belonging to previous volumes. It might thus be said that the latest edition mirrors the activities of perhaps the most fruitful year of aeronautical design and development in history. The continuous release of new information is inevitably troublesome in the final stages of preparation before the publication of such a work, and it has this year been found necessary to insert some loose "stop-press" pages.

ASSOCIATED ILIFFE TECHNICAL BOOKS

"FLIGHT" HANDBOOK A Manual of Aeronautical Theory and Practice, 4th edition — 7s. 6d. (By post 7s. 10d.)

GAS TURBINES AND JET PROPULSION FOR AIRCRAFT by G. Geoffrey Smith, M.B.E., 4th edition, 3rd impression — 12s. 6d. (By post 13s.)

WALL DIAGRAMS: Rolls-Royce Derwent, De Havilland Goblin II, Metrovick F/3 Gas Turbine — 4s. each (By post 4s. 4d. each)

TURBINES FOR AIRCRAFT (4-page colour leaflet reprinted from "Flight") — 6d. (By post 7½d.)

THE COMPLETE AMATEUR PHOTOGRAPHER by Dick Boer. Edited by A. L. M. Sowerby, B.A., M.Sc., A.R.P.S. — 21s. 0d. (By post 21s. 8d.)

PHOTOGRAPHIC SKIES David Charles, F.R.P.S. — 5s. (By post 5s. 3d.)

From all leading booksellers or from Iliffe and Sons Ltd. Dorset House, Stamford Street, London, S.E.1.

H. AND C. MOD. CONVAIR

Thrust, Cooling and Heating from an Exhaust System

IMPORTANT claims on the one hand and somewhat sceptical remarks on the other have signalled the introduction of the Consolidated exhaust augmentor system as fitted to the Convair 240. No secret is made about "the works," and a description in general terms has been available for all to read for some time past; details and figures are rather harder to come by. Certainly the addition of two jet pipes of quite impressive appearance has served to give the exceptionally clean P. & W. Double Wasp nacelle a thoroughly up-to-the-minute look.

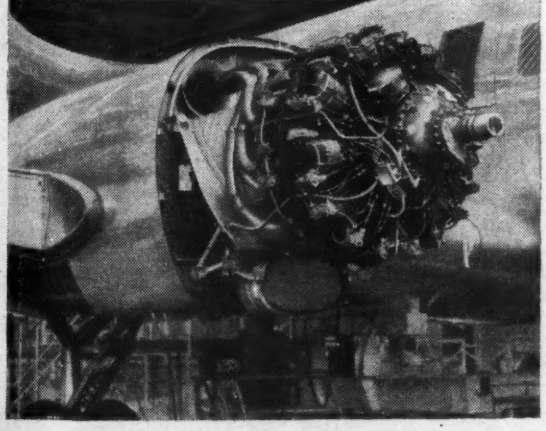
Increased thrust from the engine is not the only feature of the augmentors; in addition, the system assists engine cooling to an important extent and provides hot air for thermal anti-icing and cabin heating.

Briefly, the eighteen cylinders of the engine exhaust through branches of three pipes each and the six resulting pipes are collected into two groups of three, serving port and starboard sides. In effect, two triple nozzles are thus formed, and these are directed into the belled entries of a parallel pair of augmentor tubes. These large-bore exhaust tubes extend from the engine bulkhead, along the top of the nacelle, to the upper surface of the wing trailing edge. Here they project sufficiently to clear the nacelle rear fairing, which is attached to the landing flap.

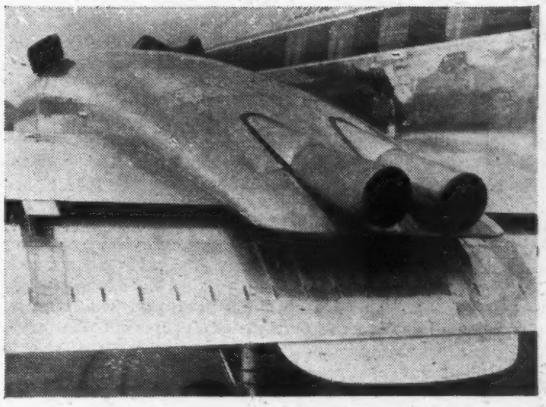
The rear section of the engine is isolated from the hot parts by inner fairings, which also serve to direct the cooling air stream upwards into the mouths of the augmentor tubes. There may be some who would be reluctant to release hot exhaust gases freely inside an engine nacelle, even though they be directed into well-insulated ducts. However, the authorities seem satisfied that there is no increased fire risk.

Air travellers have been led to expect noise level to be low in modern transports, and the Convair exhaust system in its original form is understood to have proved unexpectedly noisy for passengers seated well aft. Extended pipes have now been fitted with satisfactory results.

The problem of how to avoid wasting something like one-third of the heat energy available from each gallon of petrol fed into an engine has engaged the minds of engineers for many years. Roughly speaking, only one-third is converted into useful work, the other two-thirds which are lost being divided between exhaust heat, friction, and heat losses in the engine. The result so far as aircraft are concerned has been the development of ejector exhaust pipes, exhaust-driven turbo-superchargers and several types of compounded power unit. While there are undoubted advantages to be gained from the fitment of exhaust-driven turbines, either for driving a supercharger or geared back to the crankshaft, they have the disadvantage of adding to complication, weight and cost of a power unit. Simple devices which extract thrust from the exhaust gas are preferable for this reason if for no other.



Exhaust arrangements and the mouth of one augmentor are visible behind the Double Wasp engine.



Twin outlets of the augmentor tubes at the trailing edge of the Convairliner engine nacelle.

For the Convair 240 augmentor it is claimed that at full power (the Double Wasp gives a normal maximum output of 2,100 h.p. or for take-off with water/alcohol injection, 2,400 h.p.) thrust equivalent to 255 h.p. per engine is recovered. This represents about 13 per cent of the total heat energy of the exhaust. Expressed as performance increase without penalty on the two-motor Convair, this gives an additional 11 m.p.h. to cruising and 16 m.p.h. to maximum speed.

Aid to Cooling

Additional to this primary effect of the twin augmentor tubes behind each engine is the aid given to cooling air flow. As in a gas turbine, the primary combustion gases (in this case the exhaust gases issuing from the branch pipes at between 1,600 and 1,800 deg C) are mixed with a very large volume of cooler air which is thus heated, expanded, accelerated and expelled at high speed (1,500 m.p.h. is the figure quoted) from the jet pipe.

A Double Wasp requires about 34 tons of air per hour to cool it, and it is this cooling air which, after passing over the engine, mixes with exhaust gases in the augmentors. The exhaust gases injected into the bell entries of the augmentor tubes entrain the surrounding air in the engine compartment and induce a flow over the cylinders. This assistance to engine cooling yields several advantages. The intake behind the spinner can be of reduced size; controllable gills and outlets around the cowling are completely eliminated; cooling when stationary on the ground presents no problem, and cooling-air circulation is said to remain satisfactory even when reverse airscrew pitch is in use.

By comparison with a standard engine installation, the increased "starting power," including the reduced drag of the "exhaust-aspirated cooling system" is quoted as enabling the Convair to take off with almost 2,000 lb extra load.

There remain for description two more functions indirectly fulfilled by the Consolidated augmentor system: the provision of hot air for thermal anti-icing and for cabin heating. In place of the separate petrol heaters which are becoming common fitments on the larger aircraft, the sources of heat for both the services mentioned are the augmentors. Interconnection of the heating systems behind each engine, with control from the cockpit, makes provision against the failure of one engine.

An incidental advantage of the exhaust system, appreciated by maintenance staff, is the elimination of staining and burning on the wing surfaces. It is not suggested that this is a very serious matter with conventional exhaust systems, but it nevertheless takes time and trouble to clean wings and nacelles, and the most efficient cleaning liquids cannot always be employed because of their tendency to cause corrosion.

It seems, therefore, that considerable benefits are forthcoming in return for the relatively simple addition of augmentor pipes entirely separated from the engine and positioned quite conveniently in the top of the engine nacelle. The efficiency of the augmentors now awaits the confirmation which will result from scheduled operation with the Convair.

Internal Combustion Turbines

Six Lectures by Staff of the National Gas Turbine Establishment

A NOTABLE service has been rendered by the Institution of Mechanical Engineers in arranging, on November 3rd and 4th, six lectures on various aspects of the gas turbine. They may be regarded as a sequel to an earlier series of lectures given before the Institution in February, 1946, and which have since been a valuable source of reference. The present series, delivered by Staff members of the National Gas Turbine Establishment, Farnborough, discloses the findings of the research and development in the intervening period.

As is implicit in the titles they do not deal specifically with the aircraft gas turbine, but with efforts to determine the fundamental data essential for design in all spheres. As the lectures were, in the main, closely reasoned expositions of interrelated investigations into various phenomena affecting the performance of gas turbine power units or their components, they are scarcely amenable to intelligible condensation and should be studied *in extenso*. They will be published by the Institution of Mechanical Engineers at an early date.

Performance of Axial Flow Turbines

By D. G. Ainley, B.Sc.

IT was generally considered at the time of the early development of gas turbines for aircraft propulsion that the turbine design would probably present less difficulty than the combustion process or the compressor. Nevertheless, the early turbines benefited from advances made in the study of aerodynamics and did not follow the established methods of steam engineers. Dr. A. A. Griffith conceived that the nozzles and moving blades of a turbine should be designed to permit the gas stream to conform to a flow of constant angular momentum in the spaces between blade rows instead of neglecting completely the centrifugal forces of the swirling gas. A. Cdre. Sir Frank Whittle arrived independently at a similar conclusion and designed his turbines accordingly. With these flow assumptions, the distribution between reaction and impulse turbines, as used by steam engineers, lost a great deal of its meaning, as the reaction of a turbine stage now varies radially along the blade height, with the point of least reaction occurring at the root.

It is commonly accepted by aerodynamicists that energy losses of a fluid flow in a curved passage are considerably less when an acceleration is imposed on the flow than when the flow is accompanied by diffusion. Accordingly it was expected that an efficient turbine design of small weight and size would be somewhat easier to achieve than an efficient design of axial flow compressor. So far, test results suggest that this view was somewhat optimistic and present-day axial compressor efficiencies are often as high as those of the related turbine. As a consequence, aerodynamic research into turbine performance has been accelerated to elucidate questions such as:

(a) The effect upon turbine efficiency of blading of high or low deflection, with varying degrees of reaction, and the part-load characteristics.
(b) The effect of blade profile form and blade pitch.
(c) The effect of fluid compressibility and Reynolds number on the aerodynamic characteristics.
(d) The effects of secondary induced flows, tip clearance, shrouding, axial spacing of blade rows, length/chord ratio of blades and other factors.

A number of these factors may appear trivial, but in gas turbines a 2 per cent increase in expansion efficiency may lead to a 5 per cent saving in fuel consumption and the effect of each variable must be appreciated in order to attain maximum efficiency. Most of these problems can only be approached by the expensive process of trial and error. The few full scale tests that have been made provide only the nucleus of a general fund of data that is badly needed. Apart from full-scale tests the cascade tunnel can furnish much useful data comparatively quickly and cheaply.

Cascade tests show that the range of incidence through which both an impulse blade section and a high-reaction blade section will operate without excessive variation in loss is quite large but the reaction blade has a greater working range of incidence and the lowest loss. When a large family of turbine blade sections is tested it is found that the minimum loss co-efficient of a cascade invariably increases as the reaction of the blade is decreased. In this sense "reaction" is a qualitative expression referring to the acceleration imparted to the gas as it flows through the blades and the accompanying drop in static pressure. Such tests show that for a particular cascade the spacing of the blades must be chosen with much care to obtain a minimum profile loss. In practice turbine blade thicknesses are often more than 10 per cent of the chord at the mean blade height and maximum thicknesses are sometimes 30 per cent of the chord at the blade root.

As the Mach number is increased, the minimum profile-loss coefficient varies only slightly until an outlet Mach number of 0.7-0.8 is approached. At this point a small local shock wave appears on the convex surface of the blade some little way inside the blade passage, causing a thickening of the boundary layer and a consequent increase in loss. As the Mach number increases further the shock wave moves towards the trailing edge with a corresponding decrease of the length of blade exposed to the thickened boundary layer and results in a decrease of the loss.

The performance of a turbine is influenced by the Reynolds number for gas flow and, at a fixed incidence, the losses in the turbine increase rapidly as the Reynolds number is reduced below 1.2×10^5. Cascade tests show that when the Reynolds number is less than about 1.5×10^5 the profile loss for a particular blade is approximately proportional to $Re^{-0.5}$. In a turbine, where the mean turbulence is likely to be greater than in any of the tunnels, the critical value of the Reynolds number may be rather less than 1.5×10^5. The turbine experimental points suggest a critical Reynolds number of approximately 1.0×10^5. This leads to the conclusion that the performance of small-scale turbines or turbines intended to work with very low gas densities (as on aircraft turbines operating at very high altitudes) may be seriously affected if the Reynolds number falls below about 1.0×10^5.

It is interesting to compare the performance of an impulse and a reaction turbine both in terms of the variations of horse power and efficiency with speed, when a constant pressure-ratio is maintained, and in terms of the variation of efficiency with horse power as a constant speed. These two conditions could refer to an independently mounted power turbine in a gas turbine cycle which is used as a power unit for direct traction drive or as a power source to operate a constant-speed unit such as an electric generator or a constant-speed propellor.

The relative variation of efficiency of an unchoked reaction turbine, a choked impulse turbine and an unchoked impulse turbine are similar at constant pressure-ratio, although the absolute values of efficiency are higher for the reaction turbine.

At constant pressure-ratio, in a reaction turbine or a choked impulse turbines, the point of a maximum power coincides with the point of maximum efficiency, but the unchoked impulse turbine obtains its maximum power at a speed some 20 per cent less than the speed corresponding to maximum efficiency. This effect is associated with the increase of mass flow with reduction in speed at a constant pressure-ratio through an unchoked impulse turbine. The change from "unchoked" to the

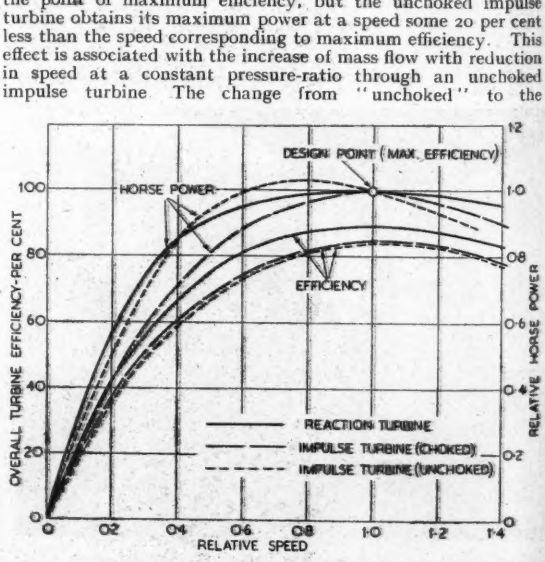
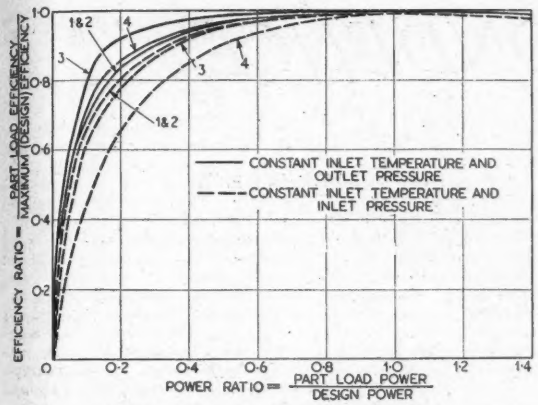


Fig. 1. Axial-flow Turbine Performance at Constant Pressure-ratio.



(1) *Reaction turbine; assumed design* $P_3/P_1=0.8$ *(4 stages).*
(2) *Impulse turbine; assumed design* $P_3/P_1=0.8$ *(1 stage).*
(3) *Impulse turbine; assumed design* $P_3/P_1=0.38$ *(1 stage).*
(4) *Impulse turbine; assumed design* $P_3/P_1=0.25$ *(2 stages).*

Fig. 2. Variation of Part Load Efficiency of Turbines Running at Constant Speed.

"choked" variation shown in Fig. 1 is gradual as the choking flow is approached.

The variation of efficiency at part-load, of a turbine running at constant speed is illustrated in Fig. 2. The part-load efficiency when the turbine operates with constant outlet pressure and inlet temperature is always better than that obtained when operating with constant inlet pressure and inlet temperature. When a turbine produces only a fraction of its optimum power, the densities of the gas flow are relatively less when working with a constant outlet pressure than when operating with constant inlet pressure. In the former case, the incidence and deflection in each blade row must be relatively closer to the optimum values to produce a particularly part-load power, and thus the efficiency will also be correspondingly nearer to the optimum.

The majority of cycles envisaged for the gas-turbine engine permit the turbine component to operate with an approximately constant exhaust pressure. Fig. 2 shows that under these conditions, the best part-load efficiencies are given by single-stage impulse turbines designed for a large pressure-drop at the optimum (design) point. Unfortunately this comparison is incomplete since no experimental characteristics exist for a high pressure-drop reaction turbine. Nevertheless the variation of part-load efficiency of low pressure-drop reaction and impulse turbines are similar, and it is conceivable that there will be little distinction between multi-stage impulse and reaction types designed for high pressure-drops. Although this comparison leaves little to choose between impulse and reaction turbines, the absolute value of optimum efficiency is invariably greatest on reaction types. Since a reaction turbine develops less work per stage than an impulse turbine, the size and weight of a turbine designed for a particular work output will become greater as the degree of reaction is increased, and a compromise between the size and efficiency often has to be made.

The Prospects of Land and Marine Gas Turbines

By Hayne Constant, M.A., M.I.Mech.E., F.R.S.

IN his lecture the author considers the world conditions under which the gas turbine for land and sea use is being developed, and attempts to assess its prospects. If some of the problems remaining to be solved are overcome, it is possible to foresee a wide field of usefulness for this prime mover. When the present world-shortage of liquid fuel is eased, the gas-turbine locomotive will become a strong competitor to the steam locomotive, and, whatever the liquid-fuel position, it will shortly be able to meet the diesel-electric locomotive on more than equal terms. The prospects for marine use turn on its ability to burn heavy residual oils.

The Part-load Performance of Various Gas-turbine Engine Schemes

By D. H. Mallinson, B.Sc., and W. G. E. Lewis, B.Sc., G.I.Mech.E

MUCH information is already available concerning the performance of the "constant-pressure" cycle both in its simple form and in its more complicated forms involving inter-cooled compression, reheated expansion, and heat exchange Such information enables the design performance of a particular engine to be estimated, but there appears to be very little published work to help the designer to foretell what changes in performance are to be expected when particular engines operate at non-design conditions.

In this lecture an attempt is made to include in a general comparison of part-load performance characteristics not only the simpler designs but also some of the more complex turbine engines which will be needed for land and marine applications. At the same time, by considering, in appropriate cases, the influence of changes in the assumed component performance features on the part-load operation of an engine, a broadening of the basis of comparison is made possible.

The Fuel Problem in Gas Turbines

By Peter Lloyd, M.A.

ACCEPTING the principle that the gas turbine is potentially capable of consuming all fuels, the author proceeds to investigate the range of possible liquids fuels and the fuel characteristics of greatest practical significance. Whilst certain properties of liquid fuels—as for example, ignition characteristics and molecular structure—are so complex that no correlation with gas-turbine combustion behaviour has been possible, yet other properties, mainly but not exclusively physical in nature, do exist for which the reverse is the case. Properties falling in the latter category are those which show relatively little variation as between hydrocarbon types or as between isomers, and include carbon/hydrogen ratio, density, vapour pressure, viscosity, and inflammability limits. The influence of these properties on the combustion process is discussed in detail under the two main heads, (a) fuel injection and stabilization of flame, and (b) the burning of the droplets after ignition, and the nature of the exhaust products.

Heat Flow in the Gas Turbine

By A. G. Smith, B.Sc.

EXPERIMENTAL data are presented on turbine-blade heat transfer, which is an important factor in the design of high-temperature turbines. Blade stagger has a considerable effect on blade Nusselt number and on the rate of variation of Nusselt number with Reynolds number. For nozzle blades, theoretical and experimental values of the Nusselt number agree fairly well. A method is proposed for the approximate estimation of Nusselt number by Reynolds analogy. The experimental data are used in the calculation of heat flow in blades cooled at the root, and in internally air-cooled blades.

Other methods of cooling have been proposed, including partial admission of cold air or liquid through the nozzle ring; the theoretically advantageous "sweat" cooling by exuding coolant air through a porous skin, or the injection of coolant air through slits; root cooling might include modifications, such as effective increase of blade conductivity by tubes of liquid embedded in the blade or reduction, by an insulating layer, of the amount of heat conducted to the blades; internal liquid cooling by forced or convective circulation is a possible alternative to internal air-cooling.

Three-dimensional-flow Theories for Axial Compressors and Turbines

By A. D. S. Carter, B.Sc., G.I.Mech.E.

IT has long been known that the energy losses occurring in an axial compressor or turbine cannot be fully accounted for by the skin-friction losses on the blades and annulus walls. The difference, usually termed secondary loss, is attributed to miscellaneous secondary flows which take place in the blade row. These flows both cause losses in themselves and modify the operating conditions of the individual blade sections, to the detriment of the overall performance. This lecture analyses the three-dimensional-flow in axial compressors and turbines, so that, by appreciation of the factors involved, possible methods of improving the performance can be investigated.

The origin of secondary flow is first examined for the simple case of a straight cascade. The physical nature of the flow, and theories which enables quantitative estimates to be made, are discussed at some length. Following this, the three-dimensional-flow in an annulus with a stationary blade row is examined, and, among other things, the influence of radial equilibrium on the flow pattern is noted.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

AIRCRAFT CARRIERS

New Conceptions Needed

I HAVE been reading the article on "Early Deck Flying," by Cdr. B. J. Hurren, in your issue of October 14th, and I should like to endorse most heartily the author's statement that "a cold and searching wind is needed to invigorate the ideas in the ships constructors' offices."

My duties for a number of years have been concerned largely with the application of aircraft to ships, and in my experience the attitude of ship designers and constructors to new conceptions in their art is conservative in the extreme.

Southampton, Hants. A. H. SHIRVALL.

PHOTOGRAPHIC PHENOMENON

Shock-wave Theory Supported

FROM the photograph of the Vampire in *Flight* of October 28th it appears that the wing is in its normal position. If the "shadow" was caused by the bending of the wing, it must have jerked back to its normal position very quickly, and it would not be unreasonable to suppose that the rest of the aircraft would also have jerked into a different position, also leaving a shadow.

A more reasonable thing to expect would be for the wing to oscillate about its normal position (i.e., to flutter), in which case it would be moving through its normal position at a maximum velocity and would, therefore, come out fainter than at its extreme displacement.

In any case, it seems inconceivable that any wing could stand up to such distortion without showing signs of it afterwards.

Shock waves have been photographed around bullets many times, so why not around aircraft?

Beckenham, Kent. R. E. WOOTTON.

COST OF M.C.A.

"The Flowers that Bloom . . ."

YOU report in your issue of October 7th that national expenditure on Civil Aviation is £71 millions annually, and receipts £28 millions. Of the deficit you state that ". . . quite a fair proportion could be saved by cutting down to one-half or one-quarter the number of people employed in the Ministry of Civil Aviation." May I say that this remark seems quite unworthy of a serious magazine. Would you be good enough to publish this letter and to justify your remarks.

The total expenditure on salaries at the Headquarters of the Ministry of Civil Aviation (according to Civil Estimates, Class VI, Vote 16) was £623,552 in 1947-48. Altogether, including out-stations, all the wardens, porters, air control and other technical staff, the Estimate for 1948-49 is £3,757,583.

If we discharged everybody, including all the met. people and air traffic control, are you satisfied that this would mean a saving of a "fair proportion" of the total expenditure of £71 millions?

Would it not be equally relevant to suggest that a "fair proportion" of expenditure could be saved by curtailing to one-half or one-quarter all prestige advertising of the civil aviation industry, without which I doubt whether your own magazine could exist? FRANK BESWICK, M.P.

House of Commons.

[*We are sorry the Hon. Member for Uxbridge should have taken our reference to the Ministry of Civil Aviation so seriously as to become peevish about it. We find it difficult to believe that all these thousands of people are really necessary, and with deficits all around, it would be a nice gesture if the Ministry were to cut down to essentials.*

We quite understand that in these days of astronomical figures, F/L. Beswick does not consider a possible saving on M.C.A. of a few thousand pounds sterling to be of any great importance. What we find it less easy to understand is the logic of his last paragraph. The cost of what F/L. Beswick is pleased to call "prestige advertising of the civil aviation industry" is paid for by that class of undertaking unfavourably known to his party as private enterprise, and it is a part of the export drive.—ED.]

BASIC SCIENCE

Putting Last Things First

THE reported resourcefulness of a large aircraft firm (*Flight*, October 21st) to provide for "standardized human-buttock forms" with "multiple indentors" is thrilling news indeed and most probably a boon for the chairborne division; it opens a true perspective on the present trend of civil aeronautics.

Being a professional heretic, I venture to visualize how basic science might be better applied, were airlines and aircraft enterprises to devote as much attention to the production of *less combustible* air vehicles. Such trifles as, for instance, the development of fuels which are *less fluid and evaporative* than petrol, appear to me preferable to a standardization of human-buttock forms.

Yet the spirit in which such "science" is being appreciated pervades civil aeronautics generally, British and American alike. When I recently tried to elaborate on the necessity of safety fuel development (and other aspects of "crashworthiness") the editor of a highly reputed technical journal deemed my contribution unsuitable. I now wonder if some formulæ on "standardized human-buttock forms," or on the pressure distribution over them, would not have met with a more sympathetic consideration.

I am afraid we may still have to go a long way in civil aeronautics, and to suffer more catastrophies, before it is learned that in practical research and development *first things must come first*, however intricate and unpleasant these first things may be. And *safety* is unpleasant to operators and manufacturers alike, because it has to be paid in cash, i.e., by a decrease in the (apparent) transport economy.

Till such knowledge of the necessity of embodying "safety first" percolates into the brains of those concerned, the mental attitude of the "standardized human-buttock form" will, unfortunately, still prevail. A. R. WEYL, A.F.R.Ae.S.

Dunstable, Beds.

PARACHUTE MEDICAL TEAMS

Flying Operating Theatres Suggested

I HAVE just finished reading a very interesting account of the Royal Air Force parachute medical teams. This is all very sound so far as it goes, but it is mentioned that the service is only a few weeks old. Now if the idea is worth introducing in 1948 with, as it is stated, no experience with regard to procedure or equipment, how much more useful would it have been when I presented to the same authority, namely, the Director-General of Medical Services, a fully documented scheme for a parachute medical service, not in 1948, but in March, 1943. I was told quite seriously that the suggestion was quite mad and of no practical value.

Previous to this I had worked out just the right amount of medical equipment, first-aid blood or plasma transfusion apparatus that could conveniently be carried by a small group of one or two medical people. It is rare to find more than one or two medically trained people anywhere near the scene of an aircraft accident, and bulky equipment is quite out of the question. I also worked out a clear explanation of what to expect at an aircraft crash; what sort of injury; what sort of wreckage, and various time-saving tricks with regard to extraction of casualties; what sort of orders I should give, and so on. These I had typed on cards, and throughout my time as a medical officer I carried these with me and handed them to any person, usually a medical orderly (but more than once my wife) to read during the journey to the scene of the crash.

What I want to know is, why the medical service is so impervious to new ideas, especially coming from its younger and more enthusiastic medical members? Just to take this parachute service as an example. The article in *Flight* of October 14th mentions medical teams to be trained one by one. In heaven's name, how long will that take, week by week? Wouldn't it be simpler to tell all medical officers to get parachute jumping experience immediately, and if the new parachute service has learned anything new, which I doubt, unless it engages itself with real cases, then dish out the information

Correspondence . . . . .

in the form of a letter to all doctors. Aircraft do not always crash at the doorstep of special units.

The fact is that the higher-up medical service authorities still have their heads firmly buried in the sand so far as actual flying is concerned. Pilots are still tested and selected as if flying an aircraft were a grim and arduous adventure; even passengers are tested and medically examined and placed in a category, just as if they were not millions of ordinary folk paying fares to fly all over the world. For front-line fighting pilots perhaps these selections have some point, but in my opinion the first and only indispensable qualification for any job is to have an interest in it. Judging by the number of wartime pilots who have never looked at an aircraft since their Service days, the Air Force must have selected an awful lot of men who were definitely not interested in flying for its own sake. My own experience has been that a genuine enthusiasm for flying has been regarded with extreme suspicion by medical authorities in charge of our Air Force.

It is this attitude which causes a parachute service to come five years after it was put forward.

Several months ago I had a long private talk with the present Minister of Health, and explained a scheme I worked out prior to the war for a flying operating theatre. Now this scheme has been tried out in practice under the name of a Mobile Operating Theatre in use for air-raid casualties. I developed this from the mobile first-aid unit into a proper operating theatre. It was presented to the Director-General of Medical Services in December, 1941, and in my view it was in ample time for the Desert Campaign in the Middle East. All equipment was planned to fit into a Wellington's interior dimensions; electrical supply, water tankage, loading, distribution of load were all carefully worked out.

A modern operating theatre is a complex affair which cannot be rigged up in a few minutes in a tent. Consider the value of a large flying boat so equipped in relation to an accident at sea or a disaster at some remote seaport town. Specialists could be operating on selected cases on the return journey, and yet the same specialist need only be away from his normal work for a few hours, or a day or so at most. The idea of a flying operating theatre is not new, but the Director-General of Medical Services thinks it is "of no practical value." Speaking as a pilot (club Austers at the moment), may I say that in an accident to myself, occurring on an airfield miles away from a hospital (and most of them are), and with an injury requiring an operation to put it right, I would far rather have the surgeon come to me with all his gadgets and paraphernalia than to suffer a long and bumpy ambulance journey: but no tents, please. I like everything laid on. This is possible in an aircraft but improbable in a tent.

Most of all, I want a fair hearing for new progressive ideas, and I do not think that I have had this. If the Minister of Health can listen, then so should his advisers.

Scarborough. J. NOEL JACKSON, M.B., B.S.

SINGLE-ENGINE PERFORMANCE
Should the Dud Be Stopped ?

A COLLEAGUE of mine had an engine failure in a Rapide recently To improve its single-engine performance he stalled the aircraft to stop the failed engine. Did he improve its performance? Have any of your readers at any time conducted flying or wind-tunnel tests on this problem? No amount of discussion has so far produced a reliable answer. Is it better to leave the dud engine windmilling or to stop it? I think it would be better to have the airscrew free-wheeling, if a free-wheel could be incorporated in the airscrew boss. But if I am right, surely this very simple "extra" would have been standard long ago. ERIC A. STARLING.

Largs, Ayrshire.

FOKKER HISTORY
More Details of the F.24

I WAS most interested to see that W/C. Maurice Smith is continuing his European aviation reviews, and that SAAB of Sweden has been followed by Fokker of the Netherlands.

W/C. Smith makes mention of the Fokker F.24, medium-range airliner, in its modified version, and this has prompted me to include below something of the rather interesting background appertaining to this aircraft.

Late in 1939, K.L.M. issued a specification for a 24-passenger, high-wing, twin-engined, tricycle undercarriage feeder-liner. Douglas submitted the DC-5, de Havillands the Flamingo, and Fokkers a new design—the F.24.

Eventually, K.L.M. ordered two Douglas DC-5s, the first of which was delivered to Surinam in 1940. Both machines were eventually sent to the Java Sea to assist in the evacuation, and were subsequently lost in action.

In 1934, K.L.M. took delivery of the Fokker F.22, an example of which was advertised for sale in last week's *Flight*, by Scottish Aviation. I understand that the F.22 created an affaire à la Tudor, and that when K.L.M. announced that an order had been placed for four F.24s, all concerned were very pleased.

A mock-up was constructed and the fuselage of the first aircraft almost completed, but the project was abandoned, presumably owing to the occupation, and nothing remained.

Very little was published concerning the F.24, and I have never seen a photograph. Some time ago, however, one of our Dutch friends was able to inspect two wind-tunnel models, and he gained the impression that the aircraft was more comparable with a present-day type than a 1939 machine. It would have been the first European nose-wheel airliner to have flown, and would have been equipped with thermal de-icing, and double mainwheels. The entrance door, when extended, formed the passenger stairway.

The F.24, in this original version, spanned 93ft and was 68ft long; the all-up weight was 28,500 lb. It was powered by two 1,700 h.p. Wright Cyclone engines and cruised at 240 m.p.h., normal range 750 miles.

London, W.C.2. JOHN S. WEBB.

FORTHCOMING EVENTS

Nov. 11th.—Royal Aeronautical Society: "French Aircraft Gas Turbines," M. Destival. (Read in English by M. Bidard.)
Nov. 12th.—Redditch Society: "Aircraft Photography," John Yoxall.
Nov. 15th.—Association of Auto-electrical Technicians: "The Electrical Starting of Aero Gas Turbine Engines," C. H. Barby, M.A.E.T.
Nov. 17th.—R.Ae.S. (Weybridge): "Some Aspects of Practical Flying," J. K. Quill, O.B.E., A.F.C.
Nov. 17th.—R.Ae.S. (Brough): "Civil Aviation," Peter G. Masefield, M.A., F.R.Ae.S.
Nov. 17th.—R.Ae.S. (Hatfield): "Design Problems of Large Flying Boats," H. Knowler, F.R.Ae.S.
Nov. 17th.—R.Ae.S. (Preston): "Investigation of Aircraft Accidents," A. Cdre. Vernon Brown, C.B., O.B.E., F.R.Ae.S.
Nov. 17th.—Royal United Service Institution: "The Gas Turbine and its Place in Service Aviation," A. Cdre. F. R. Banks, C.B., O.B.E. (Substituted for lecture by Dr. S. G. Hooker.)
Nov. 18th.—R.Ae.S. (Coventry): "Electronics," Dr. Whiteley.
Nov. 18th.—R.Ae.S. (Gloucester and Cheltenham): "Problems Facing Civil Air Operations," N. E. Rowe, C.B.E., F.R.Ae.S.
Nov. 19th.—Institute of Navigation: "Magnetic Compass Problems—A Fresh Approach," Dr. G. N. Harvey, O.B.E.
Nov. 20th.—Joint Meeting Royal Aeronautical Society and Helicopter Association of Gt. Britain. Full day Discussion on Helicopters.
Nov. 24th.—R.Ae.S. (Graduates and Students): "The Investigation of Aircraft Accidents," A. Cdre. Vernon S. Brown, C.B., O.B.E., M.A., F.R.Ae.S.
Nov. 25th.—Royal Aeronautical Society: "Development of the Armstrong Siddeley Mamba Engine," W. H. Lindsey, M.A., A.F.R.Ae.S.
Nov. 26th.—R.Ae.S. (Portsmouth): "Lighter-than-air Craft," Lord Ventry, Companion R.Ae.S.
Nov. 27th.—S.L.A.E. (South Eastern Area): "Gas Turbine Power Plants," by D. H. Mallinson, B.Sc., Manson House, 26, Portland Place, London, W.1. at 3 p.m.
Dec. 1st.—R.Ae.S. (Weybridge): "The Island Campaign," W. Courtenay, M.M., A.R.Ae.S.
Dec. 1st.—Royal United Service Institution: "Airborne Forces," Major General A. J. H. Cassels, C.B.E., D.S.O.
Dec. 1st.—R.Ae.S. (Luton): "The Light Aeroplane and the Future of Private Flying," P. G. Masefield, M.A., F.R.Ae.S.
Dec. 2nd.—R.Ae.S. (Isle of Wight): "The Development of the Armstrong Siddeley Mamba Engine," W. H. Lindsey, M.A., A.F.R.Ae.S.
Dec. 2nd.—Royal Aeronautical Society: "Problems in the Development of a New Aeroplane," G. R. Edwards, M.B.E., B.Sc., F.R.Ae.S.
Dec. 3rd.—R.Ae.S. (Portsmouth): Film, "How an Aeroplane Flies."
Dec. 7th.—R.Ae.S. (Graduates and Students): Papers read by Members.
Dec. 7th.—Handley Page Engineering Society: "Aircraft Photography" John Yoxall.
Dec. 8th.—R.Ae.S. (Preston): "Gusts," Prof. A. A. Hall, M.Sc., M.A. F.R.Ae.S.
Dec. 9th.—R.Ae.S. (Coventry): Lecture by E. Smith.
Dec. 9th and 10th.—Sheet and Strip Metal Users' Technical Association: A.G.M. and Winter Conference. Lectures:—"Impact Extrusion," Maurice Cook, Ph.D., D.Sc., F.I.M., and R. Hanes, B.A. "Pressure Welding," R. F. Tylecote, M.A., M.Sc. "Application of Phosphate Treatment to Wire, Tube and Deep Drawing, etc.," H. A. Holden, M.Sc., and S. J. Scouse. "Contact Welding," Dr. P. C. van der Willigen.
Dec. 15th.—R.Ae.S. (Weybridge): Annual General Meeting.
Dec. 15th.—Herts and Essex Aero Club: Annual Ball, Park Lane Hotel.
Dec. 16th.—Royal Aeronautical Society: "Present Thoughts on the Use of Powered Flying Controls in Aircraft," D. J. Lyons.
Dec. 16th.—R.Ae.S. (Isle of Wight): Annual General Meeting and Film Show.
Dec. 17th.—R.Ae.S. (Portsmouth): "Some Aspects of Carrier Operation," Capt (E) B. H. Cronk, D.S.C., R.N. (Retd.).
Dec. 17th to Jan. 20th.—Royal Geographical Society and Institute of Navigation: Joint exhibition "Navigation through the Ages" Lectures: Dec. 17th, "Radio and Position," Sir Robert Watson-Watt, C.B., F.R.S.; Dec. 20th: "The Navigator's Story," Prof. E. G. R. Taylor and Prof. W. M. Smart; Jan. 10th: Three films on radio systems with commentary by R. F. Hansford.

SERVICE AVIATION

Royal Air Force and Naval Aviation News and Announcements

HARBOURING A CARRIER: H.M.S. "Theseus", bearing Fairey Fireflies and Hawker Sea Furies, enters Table Bay Docks on her recent arrival at Cape Town.

R.A.F. Appointments

THE following appointments have been announced by the Air Ministry:

A. V-M. H. J. Roach, C.B., C.B.E., is to be A.O.C. No. 41 Group, Maintenance Command, and A. V-M. H. G. White, C.B.E., is to be A.O.C. No. 43 Group in the same Command. A. V-M. Roach has been A.O.C. at 43 Group H.Q. for a year, and previously commanded the R.A.F. station at St. Athan—one of the largest R.A.F. stations in the world. His successor, A. V-M. White, has served till recently as Senior Technical Staff officer at B.A.F.O. Headquarters, Germany. He commanded R.A.F. Station Halton from October, 1942, until January, 1946.

A. Cdre. G. H. Flinn, C.B.E., at present Senior Air Staff Officer of No. 205 Group, R.A.F. Mediterranean and Middle East Command, is to be the Air Officer in charge of the administration of that Group. He is succeeded as S.A.S.O., by A.Cdre H. A. Constantine, C.B., C.B.E., D.S.O., formerly Deputy Director of Organisation (Forecasting) at the Air Ministry.

Ex-Service Aid

A TOTAL of £19,000 has recently been donated to institutions for former members of the forces by the R.A.F. Benevolent Fund. £10,000 was given to the Star and Garter Home at Richmond (Surrey) for disabled soldiers, sailors and airmen for the endowment of a number of R.A.F. beds, and £9,000 has been contributed towards the cost of preparing two new British Legion Homes, one in Yorkshire, and the other in Breconshire, Wales, for aged and incapacitated ex-Servicemen.

Flying Classrooms

THE R.C.A.F. is experimenting with the first of ten Dakotas to be converted as radar, radio and navigational trainers, which are planned to carry a pilot and co-pilot, three instructors and eight trainees. The remaining nine aircraft are expected to be ready early next year.

A.T.C. Activity

MORE than 40,000 glider launches were made at R.A.F. Reserve Command units during the three months ending on September 30th, bringing the 1948 total to nearly 113,000. At the 53 gliding schools in the Command, including one in N. Ireland, 612 members of the A.T.C. passed their glider tests during this period.

Home Fleet Exercises

A MOCK battle between "Red" force —presumed to be a strong sea power —and the "Blue" submarine fleet, supported by a strong attacking air force, will be fought out during the Home Fleet's return to the U.K. early in December. The ships participating in the exercises will include the battleship *Duke of York*, the carriers *Illustrious*, *Theseus*, and *Vengeance*, three cruisers, 19 destroyers, and some 20 submarines. Admiral Sir Rhoderick McGrigor, the C.-in-C. Home Fleet, flying his flag in the *Duke of York*, will command "Red" force in attacks on Plymouth Harbour, whose C.-in-C., Admiral Sir Robert L. Burnett, will control the defending "Blue" force. The air operations by carrier-based Sea Furies, Barracudas and Fireflies, Coastal Command Lancasters, Fighter Command Meteors, Vampires and Hornets, and R.A.F. and Naval land-based bombers and strike aircraft, will be under the control of A.V-M. F. L. Hopps, the A.O.C. 19 Group, Coastal Command, as in the September exercises, when the Fleet was sailing for S. Africa and the West Indies. Realism will be increased by the use of blank ammunition.

Air Minister's Secretary

THE. RT. HON. MR. ARTHUR HENDERSON, M.P., Secretary of State for Air, has appointed Mr. A. L. M. Carey to be his private secretary. Mr. Carey entered the Air Ministry in 1939, and served in the Navy from 1940 to 1945. He was a radar officer aboard H.M.S. *Illustrious* for two years of this time

Australian Jet Production

ACCORDING to Australian reports the Hawker N.7/46 naval jet fighter will be built in quantity by the Commonwealth Aircraft Corporation. An unspecified type of British twin-jet attack bomber is to be produced by the Department of Aircraft Production. The planned output of Rolls-Royce Nene turbojets has been increased.

Canadian Question

CANADA'S Defence Minister, the Hon. Brooke Claxton, said recently in Toronto that Canada probably would not participate in the Berlin air lift until the issue had been debated by U.N.O. He stated that France, Belgium and the Netherlands were not yet taking part in the air lift, and the matter was before the Security Council.

Railway Weather Warnings

THE Air Ministry Meteorological Office service to provide local weather warnings to the railways, introduced experimentally last year, has now been brought into operation for the present winter. The comparatively mild winter of 1947-48 did not allow it to be fully tested, but forecasts were generally accurate and the Railway Executive felt that the service was sufficiently valuable to be continued. The aim of the service is to give at least six hours' warning of fog, snow, or icing to railway control officers at main traffic centres all over the country. Warnings are sent from eleven forecasting stations—Pitreavie (Dunfermline), Prestwick, Preston, Bawtry (Yorks), South Cerney (Cirencester), Gloucester, Dunstable, Uxbridge, Croydon, Upavon (Wilts) and Plymouth—which exist primarily to meet the needs of the R.A.F. and of civil aviation.

Cadets' Middle East Tour

FOUR ex-Halton apprentices who have won cadetships at the R.A.F. College, Cranwell, are spending a month in the Middle East with Bomber Command.

The tour began last week, when six Lincolns left the bomber station at Wyton on an "operation Sunray" training flight, the four cadets flying in an accompanying transport aircraft. Apart from assisting in servicing of the aircraft, and any other duties that may occur, they will record their experiences in diaries to form the basis of essays, which will be submitted to the Commandant of the R.A.F. College, A. Cdre. Atcherley, when they begin the course in January. The fortunate four are Cadets K. Smith, K. Wirdnam, A. Thomas, and I. Stevens.

Palestine Awards

IN a message to the A.O.C. Fighter Command, on the conclusion of No. 54 Squadron's successful tour of the U.S.A., Lord Tedder said that "despite all the post-war difficulties R.A.F. standards remain as high as ever they have been." Further testimony is added to that statement by the citations accompanying a list of members of the R.A.F. decorated for service in Palestine. A list of the awards, together with a brief summary of the citations, appears below.

DISTINGUISHED SERVICE ORDER

Air Vice-Marshal W. L. Dawson, C.B., C.B.E., was Air Officer Commanding, R.A.F. Levant, from Sept. 15th, 1946, until the evacuation. That all ranks in his command displayed such high morale, courage, enthusiasm and general efficiency was largely due to his personal leadership and qualities as a Commander.

O.B.E. (MILITARY DIVISION)

W/C. V. C. F. Streatfield commanded the R.A.F. station at Ramat David when it was attacked by hostile aircraft, and though confined to bed by doctor's orders at the time, within minutes he was up and in command. All attacking aircraft were shot down.

M.B.E. (MILITARY DIVISION)

S/L. E. H. G. Davey commanded No. 52 (Rifle) Squadron of the R.A.F. Regiment, and maintained among the airmen a high degree of morale and training. The squadron shot down one of the aircraft which attacked Ramat David on May 22nd, 1948.

F/L. R. F. Pope, who was signals officer at Air H.Q. Levant, succeeded in enabling radio control of the situation to be maintained throughout the evacuation, despite the hour-to-hour changes in location of H.Q.

F/L. W. W. Suckling was engineer officer of the Levant communications flight, which maintained almost 100 per cent serviceability of aircraft despite hard flying, and the fact that no extra men were available, largely through his skill, careful planning and enthusiastic work.

F/L. A. Mather, M.B., Ch.B., L.R.C.P. and S., L.R.F.P.S., carried out rescue work and gave medical attention in a most able and gallant manner, often under fire, during bomb explosions and other terrorist activities.

AIR FORCE CROSS.

S/L. C. F. Ambrose, D.F.C., commanded the forward detachments of Nos. 208 and 32 Squadrons during the critical phase of the evacuation, showing outstanding personal leadership in the air and on the ground.

B.E.M. (MILITARY DIVISION)

A/C.1 A. Vickers, an M.T. driver, set his colleagues a fine example by devotion to duty and determination regardless of difficulties or dangers. On one occasion he launched an attack unaided on thieves who were stealing equipment from a dispersed site at night. Under fire he wounded and captured one intruder and felled the other with the butt of his rifle.

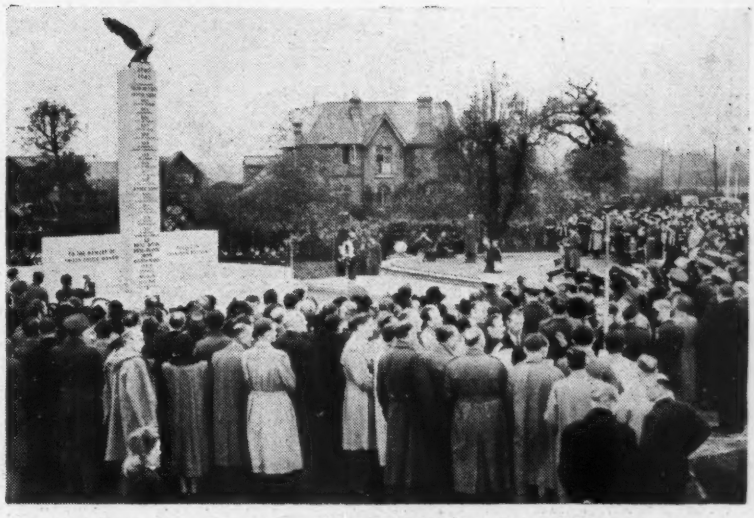
A/C.2 K. E. Hone, also an M.T. driver, came under heavy fire while driving a vehicle, receiving two wounds. With great coolness and presence of mind he kept the vehicle moving while his escort returned the fire, negotiated an acute bend in the road, and continued until the vehicle stopped from loss of petrol through bullet holes. He undoubtedly saved the loss of the vehicle, and weapons, and very probably the lives of his escorts and himself.

Cpl. H. J. Stone was in charge of a M.T. company detachment during the early days of the evacuation. He carried a heavy responsibility quite out of proportion to his rank in the successful evacuation of a maintenance unit in face of considerable danger and other difficulties.

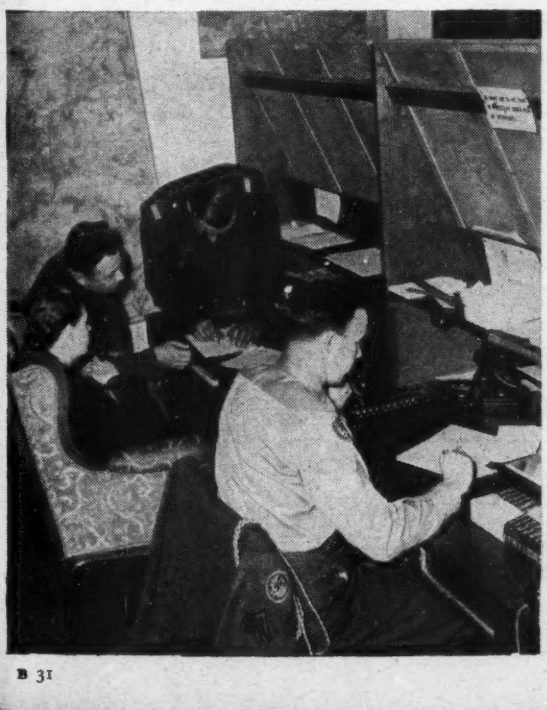
The following members of the R.A.F. have been mentioned in despatches for distinguished service in Palestine:—

Wing Cdrs. A. G. Bonny, R. M. Coad, A.F.C. Sqn. Ldrs. A. W. Brazier, W. G. K. Gorrie, D.F.C., J. F. Keith, L. A. Childs, J H. Sanderson. Flt. Lts. F. E. Dymond, J. H. Lewis, G. L. James. J. W. Patrick. F/O. R. Smyth.

W/O.s A. S. Beebee, W. R. Fraser. Flt Sgts. W. J. King, A. M. Sobey. Sgts. D. M. Digby, C. H. Webb. Cpl. D. Tebbutt. L.A/C.s W. Dailly, W. T. Darke, E. Yates (deceased).



POLISH MEMORIAL: *The scene at Northolt on November 2nd, referred to on this page, when the memorial to fallen Polish airmen was unveiled.*



HEART OF THE TROUBLE: *Inside the Berlin Air Safety Centre, which is frequently the scene of friction between Western and Soviet representatives. An American sergeant, French and Russian officers, and a Russian woman interpreter are seen on duty.*

Polish Memorial

AT Northolt on Tuesday of last week, Marshal of the Royal Air Force Lord Tedder unveiled a memorial to the 2,259 Polish airmen killed during the war. The memorial, a pillar of white Portland stone, surmounted by the Polish eagle, is situated near Northolt airport, at the junction of Western Avenue and West End Road. This site is particularly fitting, as Polish fighter squadrons operated from the airfield during the Battle of Britain. Viscount Portal, former Chief of Air Staff, referred to the part played by Polish pilots during the Battle, with a total of 200 enemy aircraft destroyed; at the end of the war the destruction of 745 enemy aircraft and 190 flying bombs had been achieved. A photograph of the ceremony appears on this page.

Another "Aries"

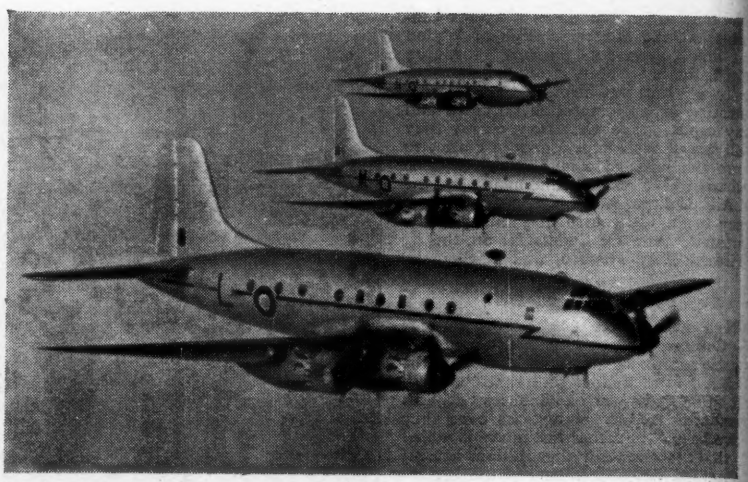
AN Avro Lincoln, *Aries III*, has now been delivered to the R.A.F.'s Empire Air Navigational School at Shawbury to replace *Aries II*, which had to be "written off" after a fire on the

Service Aviation . . . . .

ground at the beginning of this year. Like its predecessor, *Aries III* may be distinguished from bomber Lincolns by its Lancastrian-type nose and tail fairings and the absence of a mid-upper turret.

Hastings on the "Lift"

THE eight Handley Page Hastings of No. 47 Squadron, Transport Command, flew to Germany last week to increase the R.A.F. supply-carrying capacity in the air-lift to Berlin. They are based at Schleswigland, an airfield used by the Luftwaffe as a base for night fighters and V-1-carrying Heinkel 111s. A phenomenal amount of work is being done to prepare the airfield by the end of the year as a base for nearly all the British four-engined aircraft used on the air-lift. Runways are being extended and reinforced, flood lighting installed and a large hangar erected. Petrol, oil, and coal for Berlin will be flown from Schleswigland; and it is expected that more Hastings squadrons will soon be operating. Photographs of the aircraft appear on this page.



FAST FREIGHTERS : Three Hastings of No. 47 Squadron on their way to Schleswigland (above). In the lower view, German workmen are loading one of the new Handley Pages. The Hastings, with a maximum speed of 354 m.p.h., is now the speediest transport engaged in the air-lift.

Permanent Commissions

GENERAL DUTIES BRANCH

Wing Commander: L. H. Baker.

Squadron Leader: C. F. Counter, D.F.C.

Flight Lieutenants: W. A. Allinson, D.F.C., D.F.M., F. Barnes, W. L. Baxter, J. P. Bentley, D. G. Bickford-Smith, D. Bower, A. Bradshaw, D.F.C., S. A. Bunting, U. L. Burberry, E. V. Butcher, J. R. Cassels, D.F.C., F. F. Clarke, G. Clubley, D.F.C., L. F. Cosgrove, H. G. Currell, D.F.C., G. J. Daly, D.F.C., D. W. de la Rue Browne, W. G. Finlay, D.S.O., D.F.C., A. E. Flowers, J. H. Frampton, P. B. French, K. Fry, P. H. Gibbs, T. Grace, D.F.C., D. W. Griffiths, D.F.C., E. F. Herbert, E. J. Holloway, D.F.C., H. H. Lawrence, D.F.C., A. Lightowlers, J. S. Meiklejohn, R. E. Mooney, P. G. Murton, G. C. Nichols, D.F.C., C. P. Norfolk, H. G. Pattison, D.F.C., G. H. Quick, H. S. Reid, D.F.C., D. S. Richardson, D.F.C., E. A. Riseley, P. H. P. Roberts, M. Scannell, R. G. Smith, N. R. Stevens, C. J. Tedder, F. P. Walker, A. C. Warren, R. G. Williams, V. R. Withey, T. C. Woods, C. J. Woodward, D.F.C., D. H. Young.

Flying Officers: G. Amor, G. D. Bird, E. J. Clandillon, F. T. Cooper, A. G. Corfe, T. G. G. Dexter, D. T. Evans, F. D. Gunningham, W. H. Hallatt, R. A. McPhie, V. S. Montgomery, A. T. Powell, D.F.C., A. H. Turner, V. D. Young.

TECHNICAL BRANCH.

Wing Commanders: J. D. Richardson, H. C. Westwood.

Squadron Leaders: R. D. Hill, L. Newbould, W. H. Newman, W. J. Read.

Flight Lieutenants: F. Barrell, R. H. Beeching, A. R. S. Bridger, R. G. C. Castell, G. D. Cooper, M.B.E., G. V. Cowmeadow, V. T. Cox, W. R. Dunlop, L. W. Durrant, S. E. Fawson, V. E. C. Forster, W. S. Frost, A. S. Harman, C. J. W. Harold, G. L. Hart, M. F. Hatton, W. Higgins, J. E. W. Howell, P. J. Jarvis, C. G. Kehely, F. H. P. Lewer, H. Makin, L. T. A. Murchie, T. L. Nowell, L. M. Pankhurst, M.B.E., E. H. Pollard, M. C. Pulleyblank, H. C. Puxley, J. H. Ramsden, R. W. G. Ranner, J. E. Reader, A. G. Rodd, L. C. Rogers, J. A. Steven, R. S. G. Studerus, B. J. G. Theobald, V. V. Tucker, C. F. Wake, H. H. Watkinson, J. G. Webb, R. W. White, W. Wilkinson.

Flying Officer: T. L. Humble.

EQUIPMENT BRANCH.

Wing Commander: R. W. S. Cross.

Squadron Leader: R. L. Melville.

Flight Lieutenants: L. Baume, G. L. Donkersley, G. G. H. Ford, R. E. Gollop, P. D. Hodgson, M.B.E., W. J. E. Kenaelly, J. McGuire, D.F.C., J. T. Prentice, D. Rogers, D.F.C., D. F. Shepherd.

Flying Officers: N. Allatson, R. Brasnett, M. C. Burton, H. D. Elmes, M. Foley, P. E. Grew, C. E. Kearney, B. P. G. Looker, C. H. Pusey, M.B.E., F. W. Tame, T. B. Walker, E. J. White, D.F.M., E. A. Wiseman, R. Wood.

Pilot Officers: J. L. Alton, G. V. Carne, B.E.M., R. B. S. Cochrane, F. G. Galloway, N. H. Hammond.

SECRETARIAL BRANCH

Squadron Leaders: H. G. Batten, H. Booth, R. Chicken, J. I. C. Dent, C. Dunkerley, D. A. Hine, F. D. Holme, F. J. O. Lasbrey, C. N. McLoughlin, J. W. Martin, D. E. T. Osment, C. J. Pawson, F. E. Reed, P. D. Scott, B. R. Stanojlovic, O.B.E., R. Stevenson, R. G. M. Walker, D.F.C., E. M. Webb, C. C. D. Williams, A.F.C., W. J. Winter, D.F.C.

Flight Lieutenants: D. F. Baker, F. W. Brown, D.F.C., C. Burdett, D.F.C., R. T. Cahill, W. G. Chesterman, C. C. Clarke, F. S. Cocker, D.F.C., P. R. Collins, E. G. Couch, M.B.E., D.F.C., R. P. Cummins, K. Dear, W. J. de Bois, D.F.M., C. M. Donaldson, R. T. Edwards, C. B. Elford, I. G. Evans, R. I. Evans, E. W. Everett, I. S. Findley, F. R. Godsmark, W. F. G. L. Goodman, G. R. Groom, G. R. Guest, W. E. Hedley, L. W. Jackson-Wynch, D.F.C., H. R. G. Jebb, N. J. King, W. H. Langford, E. H. Lewis, T. J. Long, W. H. E. Marriott, H. W. Martin, D.F.M., G. W. Matthews, D.F.C., P. G. Maude-Roxby, R. J. Meredith, C. P. Merrick, A. G. Miles, D.F.C., F. de C. G. Morton, W. J. Norfolk, G. H. Pearce, G. Pearson, F. Pichel-Juan, D.F.C., P. W. S. Pope, D.F.C., P. J. Radford, P. J. W. Raine, D.F.C., W. D. Rooney, A. M. Sharpe, C. A. Sherwood, M. H. W. Taylor, J. H. Turner, R. Turner, S. Turner, F. Vincent, R. C. D. Vincent, R. K. Webb, N. E. Wheeler, N. White, M.B.E., S. A. White, G. E. Whiteley, D.S.O., E. F. Williams, I. M. Williams, F. W. Williamson.

Flying Officers: J. A. Abbott, S. E. Attree, G. P. Barry, J. D. Berryman, C. E. Clay, S. Davies, E. J. H. Dugmore, R. A. Farrands, J. W. Gilvey, G. R. Griggs, D. Haigh, J. F. Hall, R. A. W. Harrison, D.F.C., H. Lewis, F. W. Marriott, B. N. Mulholland, D.F.M., K. E. Muston, C. Ord, D. L. Overton, J. B. Pow, H. C. Robinson, R. F. G. Stagg, K. W. Taylor, H. W. Thackray, E. E. Watson, S. N. F. White.

Pilot Officers: K. V. Craig, W. A. Cummins, R. C. Wright.

PROVOST BRANCH

Flight Lieutenants: P. M. Graves, C. S. Harley.
Flying Officers: R. T. W. Laing, J. R. C. Proudlock, J. Rogerson, G. L. Smith, E. J. J. Squires, A. A. Witherington.

MARINE BRANCH

Flight Lieutenants: A. J. T. Bridgland, M.B.E., F. W. Fisher, M.B.E., F. J. Garwood, N. Morse J. Thompson, H. Wood.

R.A.F. REGIMENT

Flying Officers: B. Kelly, J. R. Spencer.
Pilot Officer: R. Clark.

Reunions

THE R.A.F. Stations Hurn, Harwell, Rivenhall, 38 Group H.Q., and Airborne Forces Old Comrades' Association announces a dance at the Victory (ex-Service) Club on Saturday, November 20th, 1948, at 7 p.m. Those interested should apply to the Secretary, W. Scrivens, Esq., 54, Lombard Street, E.C.3.

The Reunion Dinner of No. 255 Squadron (North African) will be held in the Criterion Restaurant on Saturday, November 20th, reception at 6 p.m. Tickets 17s 6d from S/L. V. Phillips, 56, Stanthorpe Road, Streatham, S.W.16. The dinner is open to all members of the Squadron.